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THE AMERICAN JOURNAL OF PUBLIC HYGIENE

WITH this number the American Journal of Public Hygiene becomes the official organ of the American Public Health Association, Laboratory Section.

With the assumption of its new duties it has dropped its sub-title, becoming now the American Journal of Public Hygiene, a title expressive of the exact field it aims to cover.

By the new arrangement, all members of the American Public Health Association receive this Journal, while the present subscribers and members of the local association profit by the added valuable material with no increase in price.

We trust this is but one step toward the consummation of what seems to the editorial staff most desirable,—a closer relationship between the various local public health organizations and the national association.

B. R. RICKARDS, *Managing Editor.*

TIME LIMIT *VERSUS* CULTURE LIMIT IN DIPHTHERIA RELEASE

The arguments pro and con may be stated thus:

For a time limit of two weeks from the disappearance of clinical symptoms:

1. That patients' families, knowing that the period of isolation is definite and not onerous, are less likely to conceal cases than when a bacterial limit, with all its uncertainties as to length of time, must be looked forward to.

2. That two weeks' isolation after disappearance of clinical symptons meets the requirements in most cases.

3. That actual comparisons go to show fewer "return cases" when a time limit is used than when a bacterial limit is used.

4. That it is illogical to isolate convalescents because of the presence of diphtheria bacilli, when so many infected well persons (about one per cent of the whole population) go about undetected and unrestrained.

Per contra, it may be said:

1. It would be a difficult matter to decide how many cases are concealed for fear of the indefiniteness of the culture quarantine limit, as against those concealed for fear of any quarantine at all. Figures quoted below show that many cases are released by culture before the end of a two weeks' period. The number of persons who would elect to "gamble on" the chances of early release by the bacterial limit rather than settle down to a definite two weeks' wait would vary in different communities. In any case this argument applies only to families where concealment of a case would be tolerated, and the proportion of such concealments (deliberate, and not from ignorance, etc.) to the total number

of cases should be determined before the true weight of the argument would appear.

2. While it is true that two weeks' isolation after the disappearance of clinical symptoms is about the average period during which the bacilli remain, the actual periods, as shown by Rickards recently (Boston Board of Health Report, 1906), dated from the first positive culture for diagnosis to the last of two consecutive negatives, are: less than one week, 11 per cent; between one and two weeks, 38 per cent; between two and three weeks, 27 per cent; more than three weeks, 24 per cent. Now an average of one week may be allowed from the first positive culture to the disappearance of clinical symptoms, and hence to the beginning of a two weeks' time limit, which gives an average of confinement of three weeks in all under a time limit. It will be seen that 49 per cent of those thus confined for three weeks by a time limit would have been released within two weeks by a cultural limit; 27 per cent would receive about the same amount of isolation either way; 24 per cent would be released by a two weeks' time limit while still carrying the bacilli.

A time limit, whatever it be, must necessarily confine some persons too long, and free others too soon, the proportion of these two classes to each other depending on the period selected.

3. If it be true that "return cases" are slightly more numerous with a bacterial limit than with a time limit of two weeks,* no further argument on the merits of the two systems need be considered. But these figures are based partly on a comparison of results in Baltimore (bacterial limit) and Providence (time limit), and it is quite possible that the conditions were not parallel. It is true that a comparison of English results before and after the adoption of the bacterial limit also showed that the return cases were

*This JOURNAL, May, 1907, page 229, August, 1907, page 297, "Municipal Sanitation," Chapin.

more abundant with the latter. But in all, Baltimore, Providence and London, "return" infection by either method yielded cases less than two per cent of the number of those released. In other words, it would appear that the question of time limit *versus* bacterial limit is not one to be decided by evidence as to the very obvious and overwhelming effect of either on the spread of infection.

4. The fact that so many (one per cent of the population) well persons go about infected with diphtheria bacilli is not truly an argument against bacterial release from isolation, but against any form of isolation whatever. It is not the method of terminating confinement that is brought up by this argument, but rather the question of confinement itself.

Nor is this argument as strong as it appears at first sight. As generally stated it is somewhat as follows. Suppose that in a city of 600,000 inhabitants there are 100 convalescents from diphtheria. It is now well established that in such a city there will be at any one time about 6,000 infected well persons. Why confine the 100 infected convalescents, when nothing can be done about the 6,000 infected well persons? To reduce the total infectiveness of the city by 1-61 hardly seems worth while.

We think it can be shown that the restriction of 100 convalescents is much more than a restriction of but 1-61 of the total infectiveness. Let X be the average number of bacteria present in a convalescent's throat. If one person, going about freely for one day, with X virulent bacilli in the throat be taken as a unit of infectiveness, then 100 convalescents, carrying the bacilli for an average of two weeks, represent $100 \times X \times 14$ units of infectiveness $= 1{,}400\ X$. But the 6,000 well persons carry per head a far smaller number of bacilli for a much shorter period; and only about 20 per cent of these are virulent. If we assume the bacilli to be one-third as abundant, and that no one individual of this class carries

them for more than three days, the 6,000 well persons represent 1-5 of $\frac{6,000}{1} \times 3 \times \frac{X}{3} = 1,200\ X$ units of infectiveness. In other words, the 100 convalescents do not represent 1-61 of the total infectiveness of the city, but 14-26, or rather more than half, and it is surely well to suppress one-half the infection, if this can properly be done, even if the other half is irrepressible. If, however, it be said that 6,000 persons are infected every day in the year (although not the same 6,000), and that, therefore, the time during which they are individually affected should be eliminated, the showing is somewhat different. In a city of 600,000, having an average of 2,400 cases a year, an average of 100 convalescents would exist on any one day. Hence the infectiveness of these for one year would be $100 \times X \times 365 = 36,500\ X$.

The well persons would be $\frac{6,000}{5} \times \frac{X}{3} \times 365 = 36,500 \times 4$.

Even on this showing, the convalescents would represent 20 per cent of the total infectiveness — a very different amount from 1-61 or $1\frac{2}{3}$ per cent.

We incline, however, to the former method of calculating the true relative infectiveness of these two classes, for this reason, actual infectiveness is not alone a question of potential source; it must include also a numerical estimate of the opportunities offered by the potential receivers of infection. A well-developed case of smallpox on a desert island (or in a wholly vaccinated community) has immense potential infectiveness, but no actual infectiveness. On the other hand, the small potential infectiveness of a leprous case may have, through prolonged and intimate contact with many potential receivers, a great actual infectiveness. Hence one infected person coming in contact with the same set of potential receivers for two weeks has a much greater actual infectiveness than has a person of equal potential in-

fectiveness having contact with a new and different set of potential receivers every three days. In the case of a convalescent, the set of potential receivers is likely to be fairly constant for two weeks. In the cases of infected well persons, if the average period during which each carries the bacilli be, as assumed above, only three days, the set of potential receivers changes, on the average, every three days, *i.e.*, as the particular carrier changes.

But wherever the truth may lie as regards the handling of convalescents from diphtheria, the fact seems to be that whether handled by time limit or by culture limit, rather less than two per cent of new cases are accounted for by failures in either method. Since diphtheria morbidity is not on the decrease, although its fatality is, every case of diphtheria now existing must give rise on the average to one new case. The settling of the question as to convalescents, however interesting, will necessarily leave 98 per cent of the reproduction of diphtheria unaccounted for. It would seem much more important to search for the methods to control the, as yet, evidently uncontrolled source of this 98 per cent than to devote all attention to search for those errors in handling convalescents which result in the reproduction of at most two per cent. If we may tentatively accept the teaching that diphtheria is chiefly reproduced by early, unrecognized and concealed cases, the ultimate control of diphtheria to the point possibly of abolition becomes a matter of early diagnosis — which involves culture taking from *all* sore throats, with isolation until the report is received — *or* the prompt immunization of *all* sore-throat cases, together with the immunization of all potential receivers — *or* a judicious combination of both methods, "a word and a blow — the blow first," *i.e.*, give antitoxin first, and inquire about it (by means of a culture) afterwards.

H. W. HILL.

American Public Health Association

LABORATORY SECTION

CHAIRMAN'S ADDRESS

The Laboratory Section of the American Public Health Association

By H. W. HILL, M.D.
Minnesota Board of Health Laboratories
Minneapolis, Minn.

Gentlemen: The Laboratory Section was organized in 1899 for two reasons, both of which were significant of the times.

The first reason was the great development of laboratory work, and the importance which laboratory results had come to possess in public health circles. The rise and growth of the laboratory idea is too well known to all of you for extended reference here.

The second reason was, at first sight, a trivial one. The laboratory men who, before the formation of this section, presented papers to the Association found that they were too often addressing audiences who were not familiar with their vocabulary and saw little immediate significance in the minutiæ that they presented. On the other hand, the audiences complained that the laboratory men wearied them with minute details concerning matters with which most of them had no personal connection. In fact both sides showed some impatience—good-natured and courteous enough—concerning the other, and the obvious, simple and proper proceeding was to segregate those who wished to talk laboratory matters and those who wished to talk executive matters. This impatience was, after all, perfectly natural. It did but voice something which we hardly recognized ourselves, the coming of recognized specialism, of a profession within a profession, the expert of the test tube and microscope as a recognized and fully developed figure in the profession of

public hygiene in this country. The impatience was justified because we all had specialized, and no one specialist can listen patiently to another in minute matters of detail. The formation of a Section on Vital Statistics, now in progress, is a further example of recognition of specialism. As we represent the test tube and microscope, so they represent the specialized mathematics of a technical branch of public hygiene, so technical that most of us cannot follow their vocabulary, so far removed from our subjects that few of us could adequately define the subject if suddenly asked to do so.

It would be far from fair to say or think or allow it to be thought that the establishment of the Laboratory Section initiated specialism. It did but give recognition to it. Specialism was already in existence. We had laboratories and laboratory men, engineers and engineering departments, vital statisticians, epidemiologists, experts in infectious diseases, even in individual diseases, smallpox, yellow fever, etc., in port quarantine, etc., and the specialties of each were recognized. The results of the work of each were listened to eagerly by all classes of public hygienists, but the minute technique of these branches most specialists in other lines would not wish to follow, and generally could not follow if they wished. Of course, every specialist knows that the details of his specialty cannot be made interesting to an audience other than those of his own specialty; for one excellent reason, amongst others, because they have not a common vocabulary. Hence, without meeting places where he can discuss his own work with others in the same lines, the specialist is likely to restrict his public utterances to generalities, or to the application and results of his methods in practice, knowing that for these he can usually find an attentive audience. This state of things reacts upon the specialist, for if he cannot meet his own kind for full discussion, he gradually becomes isolated in thought from his fellows; his own methods and ideas become sacred to himself; he

dislikes other people's methods and ideas because they are not his; because merely reading of them, he does not see and understand them, and so he gets off into a world of his own. If every one did this, scientific thought would gradually disappear from amongst us *or* the ancient *régime* would be revived, where there was but one man in a century who contributed anything to scientific thought, the rest being mere followers of authority. To do away with all these drawbacks, the section idea was devised, and I for one wholly believe in its value in supplying a center for the specialist where methods and results can be compared and discussed, so that the evolution of the best as the composition of forces at many hands may be attained.

The danger of the section idea lies in the fact that the specialist may find so much satisfaction in discussing technicalities with other specialists that he forgets to make clear the use in the world to which his technicalities should be put. The application and results of scientific work in the world are the real excuse for their existence, at least in applied science, and the laboratory work in public hygiene is pre-eminently applied science. It is for these reasons that I believe we should carry clearly in mind the differences between the internal mechanism by which a certain result is obtained, and the application of that result in practice, so that the laboratory man who discusses in this section the most minute technicalities should not fail to make evident also the value in practice. If this value is evident chiefly in the laboratory, then it should be described here. But no real improvement in technique and no logical and exhaustive deduction from technical results can be made without a valuable bearing on executive problems. Sometimes the bearing of laboratory advance on executive work is indirect, tending to increased accuracy or rapidity, and hence is a matter chiefly for the laboratory man. But sometimes it has a wider significance, giving to the executive a new

method of solving an old problem, or even pointing out a possible solution for an achievement heretofore supposed to be unattainable. Such contributions should be made here as to technicalities, but before the Association as to application and results.

I am accused of tending to the clerical style in fondness for parables, but I will venture on one here nevertheless. The technician bears somewhat the relation to the executive that an expert watchmaker bears to the astronomer, the navigator, the railroad man. It is the technical watchmaker's business to know all about chronometers, mainsprings, escapements, and so on. To produce a perfect timepiece, accurate and reliable, is his life, his ambition, his primary reason for professional existence. But the most perfect timepiece, unless used for something, remains merely a work of art, a triumph of mind over matter, a proof of the patience, skill, persistence, mathematical and mechanical knowledge, manual training, etc., of the maker, but that is all. It is true that any wonderfully skillful aggregation of wheels, etc., which now has no use may have a use ten years hence, undreamed of now; but if watches were mere curiosities, which some day might be useful, but for which no use could be found now, few people could afford to work at the watchmaking business, and watches would never have arrived at their present perfection.

The reasons why watches are so perfect, why technical watchmakers of the highest skill exist, are found in the fact that timepieces are essentials to the work of the world.

But the technical watchmaker's interests may stop short with the perfect watch. He may not understand or care for its applications; he need not know anything about longitude to make a perfect chronometer, still less need he be an expert navigator.

If I have made myself clear, this watch parable parallels the whole situation. As the watch itself is a sum total of

brains, mathematics, mechanics and technical knowledge, beginning with the crude ores and ending with a perfect timepiece, so the laboratory and its finished products. But as the perfected timepiece when mechanically completed is only at the beginning of its career as a useful factor in the world's work, so the laboratory results must pass into practice and be applied to executive problems if they are to bear real fruit in the progress and welfare of humanity.

If you are not weary of these analogies, I can point out more. Navigation began long before the chronometer was brought to perfection. Great sea captains made great voyages successfully without them. It is true that they navigated by guess and by gosh, but they navigated and did it well under difficulties that would put the modern sea captain out of business. It is true that they did not do the finished, polished, rapid work of the *Lusitania* or the *Deutschland*, but they did it, and all honor to them. Navigation made the chronometer, not the chronometer navigation. But the chronometer made a science of what was at best an art, a matter of tradition, experience and hard straining physical and mental effort. It resulted in division of labor and specialism; the old sea captain did everything, the modern sea captain has a navigating expert who relieves him of that particular technical branch. Meantime other functions previously exercised by the sea captain of all ages have increased in complexity and importance, in the rapidity with which they must be executed, and the scale upon which they must be done. The modern captain of a great liner could not personally superintend every detail, as his ancient predecessor could, partly because there are more details, chiefly because each has become so much greater in mere bulk. The old sea captain might easily call the roll of a dozen men: how can the modern sea captain call a roll of 800 men? Subdivision of labor is essential to the great mechanisms of today. Principles do not change with mere increase in size, but modes of applications do.

In public hygiene, certainly in those bodies which conduct public hygiene on a large scale, similar subdivision must be carried out. Just how far it must go in each case is a question of local conditions, and depends chiefly on the extent and character of the work attempted. But whenever a definite department, with specialized experts, be they chemists, bacteriologists, engineers, vital statisticians, etc., is established, the executive, in losing a technical function, gains an executive function. The executive is to execute, to accomplish, to apply technicalities to the chief end for which public hygiene exists. The less the executive must personally do of the technical details of inspection, analysis or construction, the better he can attend to the executive function of accomplishment. What then is the final distinction between executive and technical branches of public hygiene, or indeed of any other branch of applied science? It seems to me that distinctions should be made and recognized, for public hygiene is going apace and we must be ready to fit into our proper places. The day of the public hygienist who is chemist, bacteriologist, engineer, vital statistician, lawyer, inspector of nuisances and clerk of his own office is rapidly passing, at least in the larger centers. How best divide the work is the problem of the moment; for although solved in some places, it has not been solved everywhere.

The primary difference between executive and technical is, it seems to me, this: the executive deals with men and their affairs, the technician with things and their affairs. The executive must be a fine technician in handling men; the technician must be a good executive in handling things. Every one knows of good technicians who have not executive ability enough to run a laboratory: every one knows of men of good executive power who have not the proper technique in handling men. The executive is he who makes the final application of the laws of nature to the solution of a problem concerning mankind: the technician is he who, as lawyer,

engineer or chemist, statistician or epidemiologist, analyzes the case, determines the facts and indicates, if he can, the procedure which promises the desired solution.

As in all government, the legislature makes the laws, the judiciary interprets them, determines their application, and points out their effect, while the executive, fully assured on these preliminaries, accomplishes with them the desired result; so in public hygiene, nature makes the laws, the technician interprets, and determines their applicability, the executive applies them to accomplishment. As we see sometimes lawyers so interested in a technicality that they forget that the main object of the law is to do justice, so we see laboratory men so interested in mere technique that its usefulness in the world is lost sight of. As we sometimes see a governor or a president impotent in the face of a national problem, from ignorance or neglect of laws already adequate to their solution, so we see at times executives in our lines who do not know or forget the means for solution of problems which the technician familiar with natural law can supply.

A governor need not be a lawyer in order to meet a national problem, but he should exhaust the resources of his experts in the technicalities of the law before abandoning his problem as unsolvable or waiting for new legislation. So the public health executive need not be a laboratory man, an engineer or a statistician in order to solve public health problems, but he should know the possibilities of each of these technicalities as working forces, and exhaust their possibilities before confessing himself beaten, or attempting to gain his end by roundabout or inadequate, incoordinate methods.

The good navigator need not be an expert watchmaker; but he should know to the last least item the possibilities of his chronometer in navigation. He has technicalities of navigation quite sufficient to occupy his attention, about which the watchmaker may know nothing.

I do not say that a watchmaker may not make better and more valuable chronometers if he understands the purposes to which they are to be put. I do not say that the navigator is a worse navigator because he can repair his chronometer on occasion. I do say that neither need know the whole intricacies of the other's work; and in practice both watchmaking and navigation are now so elaborate and detailed that only one man here and there can be expert enough in both to handle each on the highest expert plane, *i.e.*, to secure from his work the maximum of required result from the minimum of necessary expenditure. The ideal combination is an executive who knows what he wants to do, and the lines of attack to follow; and a technical staff expert enough to follow these lines to completion, placing each finished product in the hands of the executive for use.

If I may sum up, it is my firm belief that all analogy, the experience of the ages, the spirit of co-ordination and specialism of today, go to show that the executive and technical branches of every great machine should be, and by the necessities of the case are, co-ordinate branches of one whole; and that the specialism and subdivision of labor necessitated by the universal and increasing demands of modern life make it necessary as well as obviously advisable to recognize this fact in public health circles. I believe that our section, as the first technical section of this Association, has, in emphasizing this point, done better service to public hygiene in this than any other way, notwithstanding its accomplishments of no mean order in other directions.

This humble effort of mine addressed to you today has been difficult to prepare and difficult to deliver, especially before an audience personally interested in lines which I have touched on. It will be an utter failure if it fails of its single object, to contribute to a better understanding of the relations of the technical and executive branches to the ultimate advancement of public hygiene as a whole.

Preliminary Statement by the Committee on Standard Methods of Bacterial Milk Analysis

To the Laboratory Section of the

AMERICAN PUBLIC HEALTH ASSOCIATION

ABSTRACT

At the meeting of the Laboratory Section of the American Public Health Association in Boston in 1905, at the suggestion of Prof. S. C. Prescott of the Massachusetts Institute of Technology, a Committee (of which Prof. Prescott was made chairman) was appointed to study the various methods used for the bacteriological examination of milk and to recommend a uniform procedure.

A circular letter asking for information as to existing methods and technique used in bacteriological milk examinations was sent to leading bacteriologists of the United States. Many of these it proved did not make such examinations, and the replies of those who did showed wide variations of procedure on most important points, such as plating, composition of media, incubation temperature, length of incubation, etc.

At the Mexico City meeting in 1906, Prof. H. L. Russell, of the University of Wisconsin, was appointed Chairman of the Committee, but in June, 1907, he asked to be relieved of the Chairmanship, and, by the vote of the Council of the Laboratory Section, Dr. F. H. Slack, Assistant Director

of the Boston Board of Health Laboratory, was appointed Chairman in his stead.

In view of the importance of all bacteriological milk work and the fact that much work yet remains to be done on many important points, this report is offered only as a preliminary statement, and it is hoped that much more will be done along these lines in the near future. On many points the Committee has been unable to accumulate sufficient data to formulate conclusions, and these subjects are left open for further consideration. It is requested that those who differ from the Committee on any points of technique here presented will offer data in support of their views to the Committee.

After much experimental work and careful comparison of the methods in use in various laboratories, the methods given in this report are recommended by the Committee for the present for general use in the bacteriological examination of milk.

F. H. SLACK, *Chairman.*
W. H. PARK.
E. C. LEVY.
F. C. HARRISON.
C. E. MARSHALL.
H. L. RUSSELL.

ACKNOWLEDGMENTS

The attempt has been made as far as possible to follow along the lines of the admirable work done by the A.P.H.A. Committee on Water Analysis.[1]

Information has been difficult to obtain because so few are working along these lines. Much of the matter obtained has been of a contradictory character. Some who insisted on certain points of technique have failed to respond to the request of the Committee when pressed for data supporting their views.

An earnest endeavor has been made in sifting the material obtained to keep the best methods. To all who have answered our inquiries, whether or not their suggestions have been adopted, to those who have done experimental work and to those who have by their advice and experience aided in the preparation of this report the Committee wishes to express its appreciation and thanks. A list of these is appended.

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NUMERICAL DETERMINATION OF BACTERIA.

There is no method known by which the exact number of bacteria in a sample of milk may be determined, and even when the best methods are used, the count is always less than the actual number of bacteria present, for the following reasons:

(*a*) Many bacteria in process of multiplication are held together by adhesive membranes in pairs, chains or masses. It is for the purpose of separating bacteria thus joined, as well as to obtain an even mixture, that the sample itself and the diluted sample when plating are shaken. This shaking, while it breaks up larger masses and shortens long chains, does not to any great extent break apart the shorter chains, diplococci, etc. Each of these groups of bacteria, when caught in the solid medium, develops as a single colony.

(*b*) It is impossible to obtain a medium suited to the food requirements of all species or races of bacteria.[2]

It has been found by experiment that a medium consisting chiefly of a watery extract of raw meat, alkaline to litmus and slightly acid to phenolphthalein, will furnish the best food for the greatest number.[3]

(*c*) These varying forms of minute vegetable life require varying temperatures for their best development. Many forms which will develop at room temperature will not grow at body temperature. Some require a very high temperature for their best growth.

(*d*) Some bacteria develop in an atmosphere free from oxygen, some only where oxygen is present; many are facultative growing under either condition. Bacteria which require an oxygen-free atmosphere do not develop in plates as generally prepared. Bacteria requiring oxygen, if deep in the medium, develop but slowly, as they obtain oxygen only by diffusion.

(*e*) Many forms are slow in developing into visible colonies, some requiring three or four days. On the other hand, in plates grown for several days many small colonies are obscured in the growth of larger ones.[4]

(*f*) Each bacterium requires a certain amount of nourishment for development.[5] There are also antagonistic forms which will not develop in close proximity to each other. It therefore follows that in a crowded plate, *i.e.*, over two hundred colonies, many will not develop.[6] This is easily proven by making a higher dilution.

(*g*) Spreaders and molds, by their rapid surface growth, merge with other surface colonies and obscure deeper ones.

(*h*) Samples kept in the collecting case at 34° F. for varying periods have shown a tendency to decrease in the number of bacteria which will develop into colonies.[7] Samples kept in dilution water for several hours have shown a marked de-

crease in the number of bacteria which will develop into colonies.[8]

On account of these reasons strict adherence to standard procedure is of especial importance, since there are so many points where disageement may result if uniform technique is not followed.

Since at best only approximate results can be reached in the numerical determination of bacteria in milk, and since from the varying methods in use at present counts from different workers are usually incomparable, those methods which have given best results as a whole should be united upon and adopted by all, that a bacterial count on a sample of milk may mean the same if made in any standard laboratory.

COLLECTION OF SAMPLES.

QUANTITY OF MILK REQUIRED FOR ANALYSIS. The minimum quantity of milk necessary for making an ordinary bacteriological examination is ten cubic centimeters. When making examinations for certified milk, if possible a pint or quart bottle should be taken and brought to the laboratory unopened.

COLLECTING APPARATUS. In collecting milk samples for bacteriological examination it is essential that the sample be taken and kept in such a manner as to prevent either any addition of bacteria from without or multiplication of the bacteria originally present.[9] Bottles, tubes, pipettes, etc., used in the collection of samples, besides being washed, shall be sterilized with dry heat for an hour at or about 160° C., or to the charring point of cotton.

In the selection of "certified milk" samples it is recommended wherever possible that an unopened bottle be taken, placed in a suitably iced case and brought at once to the laboratory.

Samples of "market milk" may be collected as are water samples, in sterile, wide-mouthed, glass-stoppered four-ounce bottles; the case in which they are carried being well iced.[10] The principal difficulty encountered in this method is in transferring the sample from the original container to the bottle, and the various string and wire devices by means of which the bottle is immersed in the original container are objectionable both on account of the labor of preparing such an outfit and also on account of the coating of milk left on the outside of the bottle when the sample has been taken.

An apparatus designed for the use of thirty-two test tubes as containers[11] is recommended as superior to one designed for bottles.

It has been proven that with samples kept properly iced in this particular form of case there is no increase of bacterial content even for twenty-four hours, but rather a slight decrease,[7] the counts varying hardly more than might be expected in duplicate plates. It is recommended, however, that examination of the samples be proceeded with as quickly as possible after the collections are made.

IDENTIFICATION OF SAMPLES. When bottles are used identification numbers should be etched on both bottle and stopper. Test tubes should be labeled or etched[12] and numbered.

A complete record of the samples taken, giving date, time, place, name of party from which sample is taken, name of collector, temperature of milk, character of original container (tank, can, bottle), etc., should be written opposite duplicate numbers in a blank book or pocket card catalogue, or this information may be written on small tags and tied or wired to the corresponding test tube or bottle.

TEMPERATURE. The temperature should be taken immediately *after* taking the sample for analysis, while the milk is still thoroughly mixed.

If it is desired to take the temperature of "certified milk," this should be done when the sample is taken, but from another bottle.

A floating thermometer, graduated to the Fahrenheit scale, is most convenient, and the temperature should be expressed to the nearest degree. It is necessary to standardize the thermometer for at least ten degrees on each side of the legal temperature limit. A quickly registering thermometer should be left at least one minute in the milk and read as soon as removed. A small piece of clean absorbent cotton may be used to wipe the adhering milk from the thermometer that the scale may be easily seen.

REPRESENTATIVE SAMPLES. The collector should always select his own sample, and care should be taken to secure a sample which is truly representative of the milk to be examined.

One of several methods of mixing the milk may be used, comparison having shown the results to be practically the same.[9]

1. Pouring the milk into a sterile receptacle and back.

2. Shaking the milk thoroughly with receptacle turned upside down. (This may be done where the can or bottle is tightly stoppered or capped and is not so full as to prevent thorough agitation.)

3. In open tanks in stores it is allowable to stir thoroughly with the long-handled dipper generally found in use.

4. Where the test tube collecting case is used, thoroughly reliable results are secured by first shaking the can or bottle; and, second, stirring with the large pipette before taking the sample, care being taken to close the upper end of the pipette with the finger so that no milk enters until after the mixing, or the pipette may be emptied after stirring before the sample is taken.

5. For certified milk samples it is recommended that, on arrival at the laboratory, the bottle be opened with aseptic

precautions and the milk thoroughly mixed by pouring back and forth between the original bottle and a sterile bottle. Another method is to mix as thoroughly as possible by agitation for five minutes, then burn through the pasteboard stopper with a hot iron and remove the desired amount of milk with a sterile pipette.[13]

THE INTERVAL BETWEEN COLLECTION AND ANALYSIS.

Generally speaking the shorter the time between the collection and examination of milk samples the more accurate will be the results. For routine work the attempt should be made to plate within four hours of the time of collection.

Too much stress cannot be laid on keeping the samples properly iced during this interval. They should be kept below 40° F., but care should be taken that they are not frozen.

DILUTIONS.

Ordinary potable water, sterilized, may be used for dilutions. Occasionally spore forms are found in such water which resist ordinary autoclave sterilization; in such cases distilled water may be used or the autoclave pressure increased. With dilution water in eight-ounce bottles calibrated for ninety-nine cubic centimeters and in test tubes calibrated for nine cubic centimeters all the necessary dilutions can be made.

Short, wide-mouthed "Blakes" or wide-mouthed French square bottles are more easily handled and more economical of space than other forms of bottles or flasks.[11]

Eight-ounce bottles are the best, as the required amount of dilution water only about half fills them, leaving room for shaking. Long-fiber, non-absorbent cotton should be used for plugs. It is well to use care in selecting cotton for this

purpose to avoid short-fiber or "dusty" cotton, which gives a cloud of lint-like particles on shaking. Bottles and tubes should be filled a little over the 99 c. c. and 9 c. c. marks to allow for loss during sterilization.[14]

The dilutions recommended are 1-10, 1-100, 1-1,000, 1-10,000, 1-100,000 and 1-1,000,000.

For certified milk the 1-10 and 1-100 dilutions should be used, while the 1-10,000 will usually be found best for market milk.

The 1-10 dilution is prepared by shaking the milk sample twenty-five times and then transferring 1 c.c. of the milk to a test tube containing 9 c.c. of sterile water.

The 1-100 dilution is prepared in the same way, except that a bottle with 99 c.c. of sterile water is substituted for the test tube.

The 1-1,000 dilution is prepared by first making the 1-100 dilution, shaking twenty-five times and transferring 1 c.c. of the dilution to a test tube containing 9 c.c. of sterile water.

The 1-10,000, 1-100,000 and 1-1,000,000 dilutions are made in the same manner by dilutions of the 1-100, 1-1,000 and 1-10,000 dilutions, 1 c.c. to 99 c.c. of sterile water.

It is recommended that that dilution be used which will produce about two hundred colonies to a plate, ranging from 40 to 400; where a 1-10 dilution exceeds this number the 1-100 dilution is more accurate, etc. The number of bacteria present may if desired be approximately estimated before dilutions are made by direct microscopic examination of a properly prepared sediment. Otherwise it is necessary to make a range of dilutions, thereafter selecting for record the count obtained on that plate which yields between 40 and 400 colonies.

Plating whole milk is unreliable,[15] whatever quantities be used, since the bacteria are not so well separated as in the dilutions, and often, owing to the crowded conditions, only a portion of the bacteria present will develop into visible

colonies.[6] Moreover, if a cubic centimeter of the milk is used, the turbidity of the jelly, due to the presence of the milk, hides the colonies present from the eye.

MEDIA.

The standard medium for determining the number of bacteria in milk shall for the present be agar, made according to the recommendations of the Committee on Water Analysis,[1] except that the percentage of agar shall be 1 per cent and the reaction +1.5.[2d]

All variations from agar media made as described shall be considered as special media.

Much work yet remains to be done on media; the above is recommended as giving the highest and most uniform counts so far as our comparative work has extended and with but slight variations is the medium in most common use.

STORAGE OF MEDIA. Media may be made up in quantity, tubed and stored (preferably in an ice chamber).

PLATING.

PLATING APPARATUS.[11] For plating it is best to have a single water bath in which to melt the media and a water-jacketed water bath for keeping it at the proper temperature; a wire rack, which should fit both of the water baths, for holding the media tubes; a thermometer for recording the temperature of the water in the water-jacketed bath; sterile 1 c.c. pipettes; sterile petri dishes; and sterile dilution water in measured quantities.

For milk work porous earthenware petri dish covers[16] are much superior to glass covers, since they absorb the excess moisture from the agar and prevent "spreading."

It is quite essential to the best results that the porous covers should be wet as seldom as possible. In sterilizing

them the process should be prolonged over the time necessary to kill the organisms in order that the covers may be thoroughly dry.

Straight-sided 1 c.c. pipettes are more easily handled than those with bulbs; they may be made from ordinary glass tubing about $\frac{3}{16}$ of an inch in diameter and calibrated in the laboratory.[17] They should be made about 10 inches in length.

PLATING TECHNIQUE. The agar after melting should be kept in the water-jacketed water bath between 40° C. and 45° C. for at least fifteen minutes before using, to make sure that the agar itself has reached the temperature of the surrounding water. If used too warm the heat may destroy some of the bacteria or retard their growth.

For routine work in cities in order to bring down the actual number of colonies in a plate around the standard of two hundred, it is well to use a dilution of 1-10,000. To make this dilution use two bottles of sterile water each containing 99 c.c.

Shake the milk sample twenty-five times, then with a sterile pipette remove 1 c.c., put into the first dilution water and rinse the pipette by drawing dilution water to the mark and expelling; this gives a dilution of 1 to 100.

Shake the first dilution twenty-five times, then with a fresh sterile pipette remove 1 c.c., put into the second dilution water, rinsing the pipette to the mark as before; this gives a dilution of 1 to 10,000. Shake the second dilution twenty-five times, then with a sterile pipette remove 1 c.c., and put it into the petri dish, using care to raise the cover only so far as necessary to insert the end of the pipette.

Taking a tube of agar from the water bath, wipe the water from outside the tube with a piece of cloth, remove the plug, pass the mouth of the tube through the flame, and pour the agar into the plate, using the same care as before to avoid exposure of the plate contents to the air.

Carefully and thoroughly mix the agar and diluted milk in the petri dish by a rotary motion, avoiding the formation of air bubbles or slopping the agar, and after allowing the agar to harden for at least fifteen minutes at room temperature place the dish bottom down in the incubator. The practice of mixing the diluted milk with the agar *in the tube*, leaving a certain portion of the bacteria unplated, is not recommended by the Committee.

CONTROLS. Plating should always be checked by controls. A blank plate should be made with each set of milk plates for control of the water, petri dishes, pipettes, etc.

For control on technique of plating it is recommended that for work on "market milk," duplicates be made each day on several plates.

"Certified milk" should always be plated in duplicate, and where possible it is well to have one man's work occasionally checked by another.

Unless duplicate plates show as a rule approximately the same count, the worker should see if there is error in his technique.

Racks are very useful for stacking the plates and to prevent breakage.

Plating should be done always in a place free from dust or currents of air.

In order that the colonies may have sufficient food for proper development, 10 c.c. of agar shall be used for each plate. In plating a large number of samples at one time the dilution and transfer of diluted milk to the plates may be done for four or eight samples, then the agar poured, one tube to each plate, then another eight samples diluted, etc.

INCUBATION.

Concerning incubation two methods are at present in use. Three-fifths of the laboratory workers consulted recom-

mended incubation at 37° C. for twenty-four hours with saturated atmosphere, the remaining two-fifths allowed varying lengths of time at different degrees of room temperature and at whatever degree of humidity happened to obtain.

When considering these two methods many advantages of the method of incubation at 37° C. are evident, including the ease of maintaining this temperature in any laboratory, the evident uniformity of counts so obtained in different places as compared with those obtained by the varying methods of technique, as to temperature and incubation period, where room temperature is employed, and the quickness with which results are obtained, doing away with large accumulations of uncounted plates.

Forty-eight hour plates grown at 37° C. give a slightly higher count,[11] not enough higher to materially change the report, while the loss by "spreaders" is increased and the count delayed.

To secure saturation of the atmosphere the incubator should be made with a shallow depression over the whole bottom surface, which may be kept filled with water, or in default of this a large shallow pan of water may be kept on one of the lower shelves.

Much work will be done on comparison of 37° C. and "room temperature" during the coming year.

COUNTING.

EXPRESSION OF RESULTS. Since minor differences in milk counts are within the working error of the methods and are of no significance in practice, the following scale has been adopted for recording results of market milk examinations:

Counts below 100,000 are distinguished by ten thousands.

Counts between 100,000 and 500,000 are distinguished by fifty thousands.

Counts between 500,000 and 1,000,000 are distinguished by hundred thousands.

Counts between 1,000,000 and 2,000,000 are distinguished by two hundred thousands.

Counts between 2,000,000 and 5,000,000 are distinguished by five hundred thousands.

Counts above 5,000,000 are distinguished by millions.

Therefore only the following figures are used in reporting:

Below	10,000	Above	250,000	Above	1,400,000
Above	10,000	"	300,000	"	1,600,000
"	20,000	"	350,000	"	1,800,000
"	30,000	"	400,000	"	2,000,000
"	40,000	"	450,000	"	2,500,000
"	50,000	"	500,000	"	3,000,000
"	60,000	"	600,000	"	3,500,000
"	70,000	"	700,000	"	4,000,000
"	80,000	"	800,000	"	4,500,000
"	90,000	"	900,000	"	5,000,000
"	100,000	"	1,000,000	"	6,000,000
"	150,000	"	1,200,000	etc., by millions.	
"	200,000				

Counts on "certified" or "inspected" milk shall be expressed as closely as the dilution factor will allow.

The whole number of colonies on the plate shall be counted, the practice of counting a fractional part being resorted to only in case of necessity, such as partial spreading.

Various counting devices have been recommended by different workers. The more simple ones, where the whole plate can be seen at once, are more desirable on account of there being less likelihood of recounting colonies. Colonies too small to be seen with the naked eye or with slight magnification shall not be considered in the count.

EXAMINATION OF CELLULAR CONTENT OF MILK.

Examination of milk sediment reveals certain cellular constituents which when present in abnormal quantities are often regarded as indicating a pathological condition in the animal producing the milk. Microscopical examination of these elements shows a majority of them to be polymorphonuclear cells, and these are generally considered as indicative of suppurative changes.[18]

There seems to be absolutely no relation between the number of these leucocytes in the milk and the general leucocyte content of the blood, thus indicating that a large number of leucocytes in the milk points to a local condition only.[19]

Cattle not infrequently suffer from udder troubles,—gargets of various types in which inflammatory processes of varying degrees of severity may occur. In some cases these may be so slight as apparently not to affect the nature of the milk. Often, however, the milk becomes viscous, sometimes clotty or stringy, and may even be of a bloody nature.

Occasionally such troubles as these develop into a stage in which pus is actually present in such quantities as to be easily recognizable. Milks of this character should of course be excluded from food supplies.

In these cases where a physical examination reveals an abnormal condition, a microscopical study naturally presents a far different picture from that which one obtains in apparently normal milk, and the increase in the number of leucocytes is especially noticeable.

In contrast to these cases where the physical examination and the microscopic findings are in harmony, there are many instances where, although there are an abnormal number of leucocytes present, no physical changes can be demonstrated.

Boards of health have adopted arbitrary standards in a number of instances and rejected supplies with abnormal leucocyte content on the ground that the milk was unwholesome.

Where the numerical standard set is a high one this proceeding must be commended, since there are not lacking unscrupulous people who will put on the market milk from "gargety" cows which cannot be detected by the ordinary chemical tests. The numerical leucocyte test has been the means of detecting such milk, and tracing it back to cows with manifest physical lesions in many instances.[20]

Since, however, evidence already collected warrants, beyond all question, the general statement that these cells frequently do not have the significance that has been attached to them by many observers, it would perhaps be more fair to all parties concerned to use this test at present as a means of detection only, and not condemn the supply unless physical lesions are demonstrated.

We are not prepared at this time to recommend a numerical standard to serve as a basis for such inspection. Milk having a high cell content should, however, be regarded with suspicion.[21] Such milk should be traced to its source and the cow yielding it excluded or kept under close observation if not showing definite physical lesions.

The two methods for the determination of leucocytes in vogue, (1) smeared sediment, (2) volumetric, have each their advocates according to the view point of the worker, and each possesses in its distinctive sphere points of advantage which cannot be ignored. The volumetric method may be further subdivided, some of the methods devised being quantitative only, while others are qualitative as well.

The standards so far chosen have been more or less arbitrarily selected on what appears as rather inadequate data, and from a comparison of results it is apparent that much more comparative work needs to be done.

So much has been published descriptive of these various methods that references only can be given here.[22]

The smeared sediment method has been most used for city inspection work or work of that character where, through examination of many specimens, undesirable sources of supply may be cut off.

Its advantages along this line are:

1. Smallness of sample seized, 10 c. c. being ample for all necessary tests, including bacterial count, leucocyte and streptococci estimations.

2. Rapidity of operation, exact counting being unnecessary in routine work, and as has been proved through thousands of tests, nine out of every ten samples being practically free from suspicion.

3. Since in city inspection work a smear of the sediment is often made and examined for estimation of the number of bacteria present, it is profitable to make both tests at the same time.

4. The operation for many samples is much more simple than the volumetric, and less trying on the eyes.

5. This method has been shown to give consistently lower results than the volumetric.[23] If therefore, for example, 500,000 leucocytes to a c. c. are estimated by this method, it can safely be said that the milk contains greatly in excess of that number, and to that degree is much more suspicious than would be a volumetric determination indicating 500,000.

The volumetric method has been most used for careful research work where exact leucocyte content was to be determined as nearly as possible.

It is hoped during the coming year comparison of volumetric and smeared sediment technique may give us a more exact relation between the two, and that further work by those who have herds at their command may place these examinations upon a more satisfactory basis.

DETERMINATION OF STREPTOCOCCI.[22b]

Although by careful searching a few streptococci will be found in most sediments from pus milk, they are seldom found to any great extent by direct microscopical examination. Occasionally a sample will be found crowded with long chains; more often streptococci, if present, are in the form of diplococci or very short chains.

Where streptococci, diplococci or cocci are found in the sediment and the plate from the same sample contains colonies resembling streptococci colonies, these colonies may be grown in bouillon to see if chains will develop.

First make and record an estimate of the number of such colonies present, then transfer from ten to fifty of them to bouillon and grow for twenty-four hours at 37° C. To examine the bouillon culture spread a loopful on a glass slide, fix with heat, fix with alcohol while slide is still quite hot, stain with methylene blue, wash immediately, dry and examine.

Streptococci in small numbers are present in most market milk as shown by Heinemann, and many of the short chain varieties are undoubtedly at the time harmless, though by passing through animals their pathogenicity may become marked.[24]

Long chain streptococci are considered more apt to indicate inflammatory reactions,[25] and milk containing these in large numbers is certainly not a safe article of diet.

A milk should not be condemned because a few chains are found together with large numbers of other microscopic organisms in a bouillon culture, but it is safer to exclude a milk from the market when these three tests agree:

1. Microscopical examination of the sediment shows streptococci, diplococci or cocci.

2. The plate from the same samples shows colonies resembling streptococci colonies exceeding a count of 100,000 to a cubic centimeter.

3. The bouillon culture from these colonies shows long-chain streptococci alone or in great excess as compared with the other bacteria present.

Milk showing in the stained sediment both abundance of long-chain streptococci and a high leucocyte content should be condemned as unsafe.

MICROSCOPIC ESTIMATE OF BACTERIA.[26]

A milk sediment properly prepared and examined under the microscope with a one-twelfth oil immersion lens gives a very fair idea as to the number of bacteria present.

It is also fairly easy to determine through the microscopic examination what dilution will be necessary for plating in order to ascertain as correctly as possible the number of bacteria present.

DETECTION OF GAS–PRODUCING ORGANISMS IN MILK.

WISCONSIN CURD TEST.[27] The Wisconsin curd test is conducted as follows:

1. Sterilize milk containers so as to destroy all bacteria in vessels. This step is very important and can be done by heating cans in boiling water or steam for not less than one-half hour.

2. Place about one pint of milk in a covered jar and heat to about 98° F.

3. Add ten drops of commercial rennet extract and mix thoroughly with the milk to quickly coagulate.

4. After coagulation cut curd fine with case knife to facilitate separation of whey; leave curd in whey one-half hour to an hour; then drain off whey at frequent intervals until curd is well matted.

5. Incubate curd at 98° to 102° F. by immersing jar in warm water. Keep jars covered to retain odors.

6. After six to nine hours' incubation open jars and observe odor; examine curds by cutting same with sharp knife and observe texture as to presence of pin holes or gas holes. Observe odor.

7. Very bad milks will betray the presence of gas-producing bacteria by the spongy texture of the curd and will have an off flavor.

8. If more than one sample is tested at the same time, dip knife and thermometer in hot water before each time used.

Milks showing the presence of gas or bad odors in any considerable degree are milks that have been more or less polluted with extraneous organisms or carelessly handled, and as a consequence such milks show a curd filled with small pin holes due to gas. It is not intended that this test should be used for absolute indication of the presence of gas-producing organisms, but rather it has been of service in the detection of the condition of market milk.

OTHER METHODS OF DETECTING GAS–PRODUCING ORGANISMS IN MILK. Gas-producing organisms in milk may be tested for, as in water, with glucose or lactose broth in fermentation tubes. Tests similar to presumptive tests for B. coli in water analysis may be made by inoculating into these broth fermentation tubes a c. c. each of the 1-100, 1-1,000 and 1-10,000 dilutions, or if B. coli organisms are to be numerically determined the milk may be plated in lactose litmus agar, red colonies counted and species tests worked out. Lactose-bile medium has also been used for the determination of B. coli in milk.[28]

The presence of these gas-producing organisms in abundance usually indicates dirty condition of stables, cows or vessels. In small quantities they may be found in most milks.

A rough test[29] is to place five tubes of the milk to be tested at 20° C., 27° C. and 37½° C., observing time and character of the coagulation and the odor.

This test does not require extra apparatus, uses but little milk, does not require rennet and in the hands of one familiar with the fermentation of milk gives good results.

DETERMINATION OF ACIDITY.[30]

While milk is still fresh, *i.e.*, before it has begun to undergo lactic fermentation, it will show an acid reaction which is sometimes expressed in terms of lactic acid. In view of the fact that the acidity of "sweet" milk is due partly to the presence of acid phosphates and partly to dissolved carbonic acid in milk and not to lactic acid, which is probably absent, a better plan is to express the acidity in terms of the number of cubic centimeters of tenth normal alkali necessary to neutralize a given quantity of the milk, either 25 or 50 c.c., using phenolphthalein as an indicator.

If it is desirable to calculate the acidity in terms of lactic acid, multiply the number of cubic centimeters of tenth normal alkali used by 0.897 and divide by the number of cubic centimeters of milk titrated, the result being the percentage of lactic acid. For all practical purposes the factor 0.9 instead of 0.897 may be used. For field work acidity of milk may be measured quite accurately by the alkaline tablet method.[31]

SPECIES.

In the determination of species the Committee refers to the recommendations of the Committee on Water Analysis.[32]

RECORDS.

A card catalogue is far superior to any other method of keeping records.

A series of working cards may be kept in order of the date and duplicates entered in another series in order of the place obtained, thus making it easy to refer to any day's work or to any special dairy.

Cards of different colors may be used to distinguish the different sources, such as samples taken from stores, teams, etc.

The collector may take cards with him and enter details as he takes his samples, or the sample number may be written on the test tube and the details opposite the same number in a notebook, cards being copied from the notebook on return to the laboratory.

STERILIZATION.

DRY STERILIZATION. Petri dishes, pipettes, empty test tubes, etc., are usually sterilized by dry heat.

A common gas-stove oven of large size may be used.

Empty test tubes are sterilized when the heat causes the cotton plugs to turn slightly brown; petri dishes and pipettes should be exposed to the full heat for at least one-half hour, and are best sterilized in dust-proof copper boxes in which they may be kept sterile for a long time.

Such a petri dish box may be made $4\frac{1}{2} \times 4\frac{1}{2} \times 10$ inches, with a hinged cover on one side closing over the edges and a ring handle on top.

A convenient pipette box is one 11 x 2 x 2 inches, square in section rather than round to prevent rolling, with a ring handle on the end cover.

These boxes must be made without solder, on account of the heat to which they are to be exposed in dry sterilization.

AUTOCLAVE STERILIZATION. Media, dilution water, and the rubber stoppers used in the centrifugal apparatus should be sterilized in the autoclave.

They should be kept under fifteen pounds steam pressure, which gives a temperature of about 250° F. for at least half an hour.

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APPENDIX

A. HEINEMANN.

Comparison of fourteen samples of milk plated in peptone lactose agar and nutrose lactose agar at 21° C. and 37° C. (owing to lack of space, only averages are given):

AVERAGES.

MEDIUM.	TEMPERATURE.	NUMBER OF DAYS OF INCUBATION.	NUMBER OF BACTERIA PER C. C.
Peptone lactose agar . .	21°	3	3,382,857
Nutrose " " . .	21°	3	3,185,716
Peptone " " . .	37°	1	418,000
" " " . .	37°	2	2,924,000
" " " . .	37°	3	3,002,000
Nutrose " " . .	37°	1	182,000
" " " . .	37°	2	3,245,000
" " " . .	37°	3	3,066,666

B. PRESCOTT.

Comparison of sixty plates on lactose and plain agar. Plain agar made according to Bacteriological Committee on Water, 12 grams to a liter, reaction + 1.5. Lactose agar the same with addition of 2 per cent lactose.

On 20 plates, 33⅓ per cent, the count on lactose was greater.
On 17 plates, 28⅓ per cent, the count on plain was greater.
On 16 plates, 26⅔ per cent, the count was alike.
On 7 plates, 11⅔ per cent, one plate was uncountable.

C. SLACK.

Table showing the increase in the number of spreaders as the length of time of incubation is increased and the variation according to the composition of the medium.

One hundred and seventy-four samples, each plated on four different media, making a total of 696 plates. Porous covers used. Plates examined at the end of 24, 48, 72 and 96 hours. Incubation at 37° C.

	24 Hours.				48 Hours.				72 Hours.				96 Hours.			
Media Number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Percentage of Spreaders .	4½	6	5	4½	8	17½	12	10½	13	24	26	17	16	29½	33½	21
Average per cent of Spreaders	5%				12%				20%				25%			

D. SLACK.

Tests to show whether or not bacteria increase in the test tube collecting case. (The temperature in this case is about 34° F.)

ACTUAL COUNT OF COLONIES 1-10,000 DILUTION.

Original Count.	After 4 Hours in Case.	Original Count.	After 7 Hours in Case.
5	2	136	122
0	3	133	152
8	6	146	163
8	8	830*	390*
4	4	122	114
11	8	200	183
274	221	66	74
112	101	97	79
263	200	22	21
18	5	88	103
220	315		
196	143		
650	420		
70	60		
411	305		
275	235		
156	171		
115	159		

* There was evidently some technical error in the plating of this sample.

Original Count.	After 6 Hours in Case.	Original Count.	After 4 Hours in Case.	After 24 Hours in Case.
52	43	589	586	578
1178	1016	816	834	633
1363	1084	607	670	703
1216	1075	258	230	291
192	196	895	930	960
93	81	78	66	76
37	24	177	151	123
322	258	83	69	77
298	309	92	133	103
36	39	124	82	95
		2	1	1

Since the variations are hardly more than might be expected in duplicate plates made at the same time, we conclude there is not only no increase in the number of bacteria between time of collection and plating, but usually a slight decrease.

E. SLACK.

Tests to show whether or not bacteria increase while dilutions are being made and ultimate fate of milk bacteria in water.

Original Count.	After 15 Min. in Dilution at Room Temperature.	Original Count.	After 4 Hours in Dilution at Room Temperature.	After 24 Hours in Dilution at Room Temperature.
54	40	150	28	Est. 1000
2	1	415	147	Innumerable
3	0	1085	133	Innumerable
5	15	655	92	Innumerable
315	347	Est. 2400	680	Innumerable
143	117	257	115	Est. 1100
60	56	Est. 1500	202	17
137	135	Est. 1200	311	Innumerable
73	71	Est. 1200	369	Innumerable
100	87			
25	10			
101	102			
132	143			
59	59			
66	61			
3	3			
158	147			

Original Count.	After 6 Hours in Dilution at Room Temperature.	After 28 Hours in Dilution at Room Temperature
10	8	Innumerable
11	8	Innumerable
6	3	Innumerable
20	1	18
562	102	160
6	0	63
9	7	Innumerable
0	0	1
80	2	10
93	12	Est. 600
102	10	112
0	1	0
1	3	0

From these experiments we are led to conclude that during the few minutes the milk is in the dilution water there is no increase in the number of bacteria. On the contrary, for the first few hours there is usually a marked decrease which sometimes persists, but usually forms are present which eventually multiply exceedingly.

F. STOKES.

Stokes recommends a copper box holding twelve two-ounce sterilized glass cologne bottles, etched with diamond ink for labeling. These bottles are held in flat tin holders, having intervals between each series of four in which ice can be placed. Each bottle has wire attached wrapped around the neck and the stopper. This can be pulled out so that the bottle can be slipped in each milk can without contaminating the cans from ladles slipped in other cans, or by the fingers of the inspector. Bacteriological and chemical tests are carried out with these samples.

G. HEINEMANN.

Recommends as the result of repeated measurements filling dilution bottles to 100 c.c.; approximately 99 c.c. remaining after sterilization.

H. CAMPBELL.

Tests comparing the plating of 1-20 c.c. of whole milk with the ordinary dilution methods.

TESTS COMPARING THE PLATING OF 1-20 C. C. OF WHOLE MILK WITH THE ORDINARY DILUTION METHODS.

1-20 c. c. Whole Milk.		Dilution 1-20.		Dilution 1-100.	
Number of Colonies.	Count.	Number of Colonies.	Count.	Number of Colonies.	Count.
712	14,240	1,109	22,180	401	40,100
688	13,760	1,042	20,840	365	36,500
181	3,620	257	5,140	98	9,800
173	3,460	229	4,580	87	8,700
660	13,200	870	17,400	220	22,000
720	14,400	680	13,600	200	20,000
185	3,700	415	8,300	141	14,100
616	12,320	1,030	20,600	331	33,100
202	4,040	210	4,200	49	4,900
200	4,000	237	4 740	128	12,800
232	4,640	129	2,580	71	7,100
340	6,800	.....	.....	224	22,400
449	8,980	.....	.....	217	21,700
128	2,560	200	4,000	.....	.....
110	2,200	240	4,800	.....	.....
118	2,360	128	2,560	.....	.....
96	1,920	140	2,800	.....	.....

I. GAGE.

A calibrating device copied from one in use by S. DeM. Gage of the Lawrence Experiment Station is convenient. By means of a three-way stopcock, mercury, from a reservoir, is filled into the tube to be calibrated, then a c. c. by weight is withdrawn and the tube marked. The whole system is first filled with mercury, care being taken to expel all air from the escape tube. The pipette to be calibrated is inserted, small end up, and filled with mercury from the supply tube until a drop stands on top; the flow is then stopped and the drop of mercury on top of the tube brushed off with the finger. Exactly 13.6 grams (1 c. c.) of mercury are then allowed to escape into the pan on the balances, the pipette is marked at the place where the mercury then stands with

hydrofluoric acid, then the remainder of the mercury in the pipette is run into the pan on the balances, the flow stopped and a new pipette inserted, the mercury in the pan poured back into the reservoir and the operation repeated.

Instead of weighing the mercury each time, it may be run as suggested by Wesbrook into an accurately graduated 1 c. c. receptacle. By rubbing the pipettes before calibration, while hot, upon a paraffin block, they may be coated at about the point where the mark will come. A ring cut through the paraffin at this point is filled with hydrofluoric acid for five minutes and leaves a fine cut mark.

J. STONE AND SPRAGUE.

Blood taken from ear at same time milk sample was secured. Blood count made with Thoma Zeiss counter. Milk counted by Doane-Buckley method. (Owing to lack of space details are omitted.)

Of the 58 cows examined there were 12, or 20 per cent, which showed a milk leucocyte count of over 500,000; 5, or 8½ per cent, with a milk count of over 1,000,000; and there were 7, or 12 per cent, with a blood count of over 10,000 leucocytes per m. m., and 1, or 2 per cent, with a blood count of over 20,000. The number with a low blood count (under 6,000) was 20, or 34 per cent.

The number having both a high blood and milk count was nil, and the number with a low blood count and a high milk count was 6, 10 per cent of the whole number, and 50 per cent of the number showing high milk count.

There seems to be absolutely no relation between the number of leucocytes in the milk and the general leucocyte content of the blood, thus indicating that a large number of leucocytes in the milk points to a local condition, if of any consequence at all.

That a high leucocyte count in either blood or milk is a comparatively constant factor is indicated, since in nearly

every case second and third counts correspond very closely with the first.

K. RUSSELL AND HOFFMANN. Modification of Doane-Buckley method for estimation of leucocytes.

COLLECTION OF SAMPLE.

Sample for analysis should be taken from the entire milking of the animal, as the strippings contain a somewhat larger number of cells than other portions of the milk. For the purpose of examination take 200 c. c. in stoppered bottle.

TIME INTERVAL BETWEEN COLLECTION AND ANALYSIS.

To secure satisfactory results, milk must be examined in a sweet condition. Development of acidity tends to precipitate casein in the milk, and thus obscure the examination of microscopical preparations. Samples received from a distance can be preserved for satisfactory microscopical examination by the addition of formalin at time of collection — proportion of 1 c. c. to 250 c. c. of milk. Formalin has been found the best preservative to use, although it causes contraction of the cells to some extent.

PROCEDURE WITH REFERENCE TO PREPARATION OF SAMPLE.

1. HEATING SAMPLE.

To secure the complete sedimentation of the cellular elements in the milk, it is necessary to heat the same to a temperature which will break down the fat globule clusters, or lessen the ordinary creaming properties of the milk. Samples should be heated at 65° to 70° C. for not less than ten

minutes, or from 80° to 85° where very short periods of exposure (one minute) are given. This treatment causes the more homogeneous distribution of the fat globules through the milk, and when the sample is then subjected to centrifugal force the cell elements are not caught in the rising fat globules, but on account of their higher specific gravity are concentrated in the sediment by centrifugal force.

2. CONCENTRATION OF CELLULAR ELEMENTS.

Ten c. c. of milk are placed in an ordinary sedimentation tube, and after heating as above directed, and subsequently shaking, the milk is centrifugalized twenty minutes at 1,200 revolutions per minute. A hand centrifuge may be employed for this purpose, but where available a steam turbine Babcock milk tester may be found more practicable.

NOTE. — This speed, maintained for the time mentioned, is sufficient to sediment practically all the cell elements suspended in the milk. In our experience we have found the number of cells in supernatant milk to average only 3½ per cent.

3. PREPARING THE SAMPLE FOR EXAMINATION.

After centrifugalizing, the cream and the supernatent milk are removed, with the exception of the last half c. c., by aspirating with an exhaust pump and wiping the walls of the tube with a cotton swab. After thoroughly mixing the sediment with a glass rod, enough of the emulsion is placed in an ordinary blood counter (Thoma Zeiss pattern) to fill exactly the cell. The preparation is then allowed to stand for a minute or two to permit the cellular elements to settle to the bottom of the cell, while the few fat globules in the liquid rise to the surface. This method permits of the differentiation of the cells from the small fat globules, so that a distinct microscopic observation can be made.

EXAMINATION OF MATERIAL.

The preparation is examined in an unstained condition.

NOTE. — Most observers have usually stained the sediment prior to examination, but we have found with the above treatment that the cells may be enumerated quite as well in an unstained as a stained condition.

The count is made with a 1-inch eyepiece and $\frac{1}{6}$ objective. Where the number of cell elements exceeds 12 or 15 per microscopic field, above referred to, one-fourth of the entire ruled area of the counter, equivalent to 100 of the smallest squares of the cell, are counted. Where the cell elements are less abundant, one-half of the cells in the entire area (two to four hundred squares) are enumerated. The average number of the cells per smallest square is then obtained, which, when multiplied by 200,000, gives the number of cells per cubic centimeter in the original milk. (If multiplied by 4,000,000, we have the number of cells per cubic centimeter in the sediment examined. As the sediment represents the concentration of the cells into one-twentieth of the original volume of milk taken, 10 c. c. to one-half c. c., this number should be divided by 20 to give the number of cells per cubic centimeter in the original milk.)

NOTE. — The above factor of 4,000,000 is obtained as follows: The cubic content of the blood counter represents one-tenth of a cubic centimeter. This volume is divided by means of the ruled scale into 400 small cubes, each equal to one four-thousandth of a cubic millimeter, or one four-millionth of a cubic centimeter.

EXPRESSION OF RESULTS.

All results should be expressed in numbers of cells per cubic centimeter of the original milk, and in order to avoid fictitious accuracy, should be given in accordance with the method adopted by the Committee on Standard Methods of Water Analysis, as reported in this Committee's report

to the Laboratory Section of the American Public Health Association for 1905, page 94.

L. SPRAGUE.

Comparison of Doane-Buckley and Hill-Slack (modification of Stewart's) methods of estimation of leucocytes:

Cow.	Hill-Slack Method.	Doane-Buckley Method.
1	252,827	580,000
2	241,100	485,000
3	548,900	875,000
4	252,800	595,000
5	199,600	510,000
6	249,500	985,000
7	282,700	899,000
8	332,600	570,000
9	532,200	640,000
10	153,000	846,000

REPORT OF THE COMMITTEE ON STANDARD METHODS OF WATER ANALYSIS, 1907

A Committee on Standard Methods of Water Analysis was appointed at the meeting of the Laboratory Section of the American Public Health Association at Minneapolis in 1899. As a result of the appointment of that Committee an elaborate report on standard methods of water analysis was made at a meeting of the section at Havana in January, 1905, and this report was published in the Journal of Infectious Diseases, Supplement No. 1, May, 1905, and reprints of this report bound for distribution.

It was attempted in that report to give in full such methods of physical, chemical and bacteriological examination of water as at that time met the approval of the Committee, were used in up-to-date laboratories, and could be recommended for general use. Since the publication of that report, three years ago, no attempt has been made by the Committee to again report at any length upon this subject, and the Committee as now formed does not believe that it is either desirable or feasible to make any extended report at the present time. It believes that such reports as that of 1905 enter so elaborately into all details of sanitary water analysis that taken as a whole they should stand for a number of years, probably for five years at least.

The Committee recognizes the fact that new methods of both chemical and bacterial analysis and improvements upon older methods are being constantly proposed and practiced, but the Committee believes that such new methods or improvements of older methods should not be incorporated into a report upon standard methods until after a season of trial in many laboratories. The Committee also recognizes that methods of analysis, useful and of some value in some laboratories, are of less value in others, owing to local conditions, the class of waters to be examined, etc. At the

present time therefore it is not proposed to make anything in the nature of a new report, but simply to suggest such work in various laboratories as will be of help to the Committee when the time arrives for a new report to be submitted and published. At the present time few changes of or additions to the chemical methods presented in the report of 1904 have been suggested to the Committee, and such as have been suggested need, in the opinion of the Committee, a thorough trying out. It should be the aim of laboratory workers, as well as of the Committee, to investigate and approve methods that are an actual improvement over older methods, and not simply different from these older and standard methods. If the new methods are intended to save laborious laboratory work and yet accomplish as good results, both labor saving and accuracy should be proved before the methods are adopted.

It is suggested that it may be necessary for this Committee to formulate methods for the interpretation of water analysis, but it is doubtful in the minds of some of the Committee whether such a procedure is necessary.

The following chemical methods are perhaps worthy of study at the present time:

The so-called Brucine method for the determination of nitrates.

The determination, by the so-called methylene blue test, of the stability or non-putrescibility of the effluents of sewage filters.

Studies of the value of the various methods for the so-called oxygen consumed determination.

The practicability of direct nesslerization for the determination of free ammonia, and for the direct reading method for Kjeldahl nitrogen.

Some of these methods when tried in certain laboratories, during the past few years, have been pronounced of little value, while in other laboratories a different estimation of

some or all of them is held. Before any of these methods of analysis are deemed worthy of being incorporated in a report upon standard methods, however, many laboratories should be heard from in regard to them.

In bacterial work it is suggested that a standard method for the determination of the colon bacillus should be formulated, and it is proposed that certain features of the usual method be modified as follows:

a. By omitting the determinations of motility.

b. By omitting tests for coagulation of milk when cultures have been isolated by lactose agar plates.

c. By omitting determinations of the amount of gas formed and the gas ratio in either presumptive or confirmatory tests.

d. By allowing the use of bile broth as an alternative for Smith's solution or pepton dextrose broth.

It is also suggested that agar be substituted for gelatin as the standard medium for the determination of numbers of bacteria, and in this connection it is believed by some that counts of bacteria should be made on plates incubated at at least two different temperatures.

It is also suggested that the Committee should consider the formulation of some standard method for the determination of streptococci, for enteritidis sporogenes and for S. choleræ.

During the coming year, therefore, the Committee, if continued, proposes to secure in various laboratories special investigations of the points mentioned, and will report in regard to these investigations, etc., at the next annual meeting.

Respectfully submitted,

H. W. CLARK,
Chairman, for the Committee.

The Massachusetts Association of Boards of Health

OCTOBER QUARTERLY MEETING
Boston, Mass.

The quarterly meeting of the Massachusetts Association of Boards of Health was held at the Hotel Brunswick, Boylston Street, Boston, on Thursday, Oct. 31, 1907, President Walcott presiding.

After luncheon the President called the Association to order for business.

On motion of Dr. Durgin, the reading of the records of the July meeting was dispensed with.

Upon the recommendation of the Executive Committee, the following gentlemen were elected members of the Association:

Sidney J. Wright, of the Holyoke Board of Health.

Samuel C. Prescott, Massachusetts Institute of Technology.

Walter E. Kruesi, Secretary, Boston Association for the Relief of Tuberculosis.

William H. Fennell, of the Lawrence Board of Health.

THE PRESIDENT. The first business of the afternoon is a paper by Dr. Stowell of Boston, upon "The Possibilities of a Clinical Laboratory in a Country Town in Relation to Public Health Work."

THE POSSIBILITIES OF A CLINICAL LABORATORY IN A COUNTRY TOWN IN RELATION TO PUBLIC HEALTH WORK

By DR. E. CHANNING STOWELL
Boston, Mass.

Mr. Chairman, Ladies and Gentlemen: When I was asked to tell the story of the little clinical laboratory, established in Dublin, N.H., I was glad to comply, because I hoped that hearing of our experience others might go and do likewise.

I am in practice there in the summer. Several years ago it appeared that there were cases of illness occurring during the summer for whose proper care I needed the services of a laboratory. There was an occasional case of diphtheria brought to the town by some of the servants who had been on a holiday to neighboring communities or by visitors from elsewhere. There were groups of cases of streptococcus infection. There were occasional cases of typhoid, brought from the steamer by returning travelers or from other infested places. I have never known a case of typhoid to originate in that community in the ten years that I have been there. Then there were groups of cases of intestinal infections occurring in the hottest part of the summer in both adults and children, due in all probability to a faulty milk supply. There were also every year groups of other infections, taking the forms of sore throats, of bronchitis, or of diarrhœa, which occurred sometimes early, sometimes late in the season.

I felt that I needed a laboratory as a tool to properly investigate and treat these series of cases. In the fall of 1906 I made an appeal to some of the men and women there. I approached, at first, only a few, for the reason that the fewer

interested during the first years, until the experiment was thoroughly tried, the less discussion, the less trouble there would be. Those who were spoken to were the right persons, and they agreed to raise a sum of $1,000 for the equipment of a laboratory and the salary of a laboratory worker for one year, as an experiment.

During the winter while I was formulating a plan and testing the possibilities and difficulties of the project much encouragement was given by those who were interested in public health in Boston. Professor Sedgwick, Professor Leary and Mr. Rickards all gave me much help and advice and sympathy. The greatest difficulty to be overcome was the fact that a country town has no gas supply. We could not afford to establish a gas plant of our own. We had to rely upon oil for heating the incubator, for the sterilizing apparatus, for the blast lamp and for cooking purposes. Alcohol, except in a small way, would not have been satisfactory for the above purposes. There is an electric lighting plant in the town, but the power available is limited and the light is only supplied from sunset until midnight. There are incubators on the market which have a water-jacket and are heated by a kerosene lamp. Up to the present we have not been able to work these satisfactorily. This summer we have used a Cyphers chicken incubator. This machine, as you know, has no water-jacket, but the interior is kept warm by a current of heated air. After a long series of careful temperature tests, we became acquainted with the eccentricities of the machine and were able to use it with excellent results throughout the summer. Standard solutions, serum media and some special test solutions we bought of reliable makers in Boston. Our glass and chemicals we obtained through the regular dealers.

Then came the question of a building. One of the residents offered me a barn. It was an ancient structure and had originally been used as an ox barn. Later, when the farm

was no longer worked, it had been used as an artist's studio, and picture exhibitions had been held there. One summer Carl Baerman used it for a practicing room and gave a Beethoven recital there. Finally this year it fell into the hands of the bacteriologist. With the aid of a handy carpenter we fitted it up with benches and sink and desks, so that our work went very smoothly. We had no running water in the building, so all our water was carried in pails a distance of 200 feet from the lake. This was a labor of love on the part of the laboratory assistant. The distilled water we bought in carboys in Boston. The assistant, Dr. Wm. H. Sayward, Jr., of Wayland, was a gentleman highly recommended by Professor Sedgwick, who had taken up laboratory work for the time. He came to us for a salary of $75 per month, and we were able to give him for himself and family the use of a small cottage on one of the estates of a summer resident, who had been exceptionally generous in helping the laboratory.

The work we undertook to do was, in the first instance, the study of the local mosquito question. As far as we know the anopheles have not been found in Dublin. The problem, therefore, was not of the mosquito as a disease carrier, but as a pest and discomfort to the community. This study took a great deal of time and labor off and on during the season, but led to such definite results that we were able to make some suggestions for work next year, which promises to be of benefit to the whole community.

Then we took up the sanitary analysis of drinking water, and we were enabled to point out several unsafe sources of water supply as well as to prove that other suspected sources were excellent. A great many of the summer residents get their water from Dublin Lake itself. A careful study of this water was made at different times, under different conditions and at different stations. This study and its results we hope to publish.

We also studied the milk of one producer quite carefully all through the summer. We did him a great deal of good, and through him the other milk producers of the neighborhood; for he came to see that the bacterial count varied directly as there was extra care or carelessness at the barn and dairy. This of course he saw was to be a matter of dollars and cents with him another year. It was due to our counts that he was enabled to charge ten cents a quart for his milk. Also we did the ordinary clinical examinations of the urine, of blood, of pus and of throats. We were prepared to examine for tubercle bacilli and also do the animal inoculation test. We did the Widal reaction. We were prepared to make chemical examination of stomach contents, and for lead and arsenic; in short, to do all the ordinary medical laboratory work and to serve as a go-between in any extraordinary tests.

The use of the laboratory during this first summer was in the main confined to the little community of Dublin. The hope, however, is that interest will spread, and that it may be made use of by all the medical profession of the county. No great attempt was made this summer to advertise the work that we were trying to do; but not a few calls for examinations were made from near-by towns. The year's report of work done was satisfactory to the contributors, and we have the assurance of their support for another season. The expense amounted to between $600 and $700, of which $300 was for the salary of the assistant.

THE PRESIDENT. This interesting account of a new machinery to assist us in our public health work is now before you for discussion or for question.

DR. DENNY. I think the subject which Dr. Stowell has brought up is a very important one, especially for boards of health. Boards of health are establishing laboratories in comparatively small places now, and a great deal of the work which Dr. Stowell has spoken of doing in the laboratory

at Dublin might be done in these laboratories. In addition to the diagnosis of contagious diseases, examinations for the diagnosis of the non-contagious diseases might also be made. Great progress has been made in medical science during the last few years in clinical microscopy, but the community as a whole has very little benefit from these advances. A laborer in the city, a foreigner perhaps, is taken to one of our city hospitals when he is sick and has the benefit of a clinical laboratory to aid in the diagnosis and correct treatment of his case. But outside of the large cities the citizens of this Commonwealth have very little benefit from the progress that has been made in medical science along these lines, and I think that the board of health laboratories could undertake very well to do some of this work. In 1899 the Brookline Board of Health undertook to make such examinations in the laboratory in Brookline, and a circular, signed by the Board of Health, was sent to all the physicians, which began as follows:

"Believing it to be in the interests of the public health that there should be a laboratory in the town where the various microscopical and chemical examinations now used in the diagnosis of disease can be carried out, the Board has decided to afford facilities for the making of these examinations in the laboratory recently established for bacteriological work. These examinations will be made for a moderate fee for any physician of the town or for any physician who is attending a resident of the town."

These facilities have been made use of only to a limited extent, but I think the physicians of the town have appreciated it. The influence of a laboratory and the habit of coming to the laboratory and making use of such examinations raise the standard of medical practice. Instead of working in the dark a physician naturally stops and thinks what he can use to aid in the diagnosis of his case. I am frequently called up by physicians, a case is described, and

I am asked if any examination will be of aid in the diagnosis of that case. I think that this habit of turning to the laboratory is a very helpful one. If there were more laboratories started where physicians could have the benefit of clinical microscopy the standard of practice in our suburban and country districts would be very much raised.

DR. WHEATLEY. I should like to inquire, through you, Mr. Chairman, of the last speaker, in regard to the expense in Brookline.

DR. DENNY. It is a source of income to the laboratory, because examinations which are of benefit to the individual only, and not to the community as a whole, should be charged for. These examinations have, therefore, been a source of income — very slight, but still something.

THE PRESIDENT. Dr. Emerson, have n't you had some experience with this matter in Springfield?

DR. EMERSON. Mr. President, this is a matter which has interested me ever since I went into the medical practice. I started in Springfield with a small incubator and microscope — that was about all I had at first — and began doing a little work locally for the Board of Health in diphtheria some ten years ago. Since that time our laboratory has developed, and we have done the work for the city of Springfield, making the ordinary bacteriological tests for diphtheria, tuberculosis and typhoid. I have also done considerable of that class of public health work for the neighboring cities and particularly the smaller towns, so that at the present time we do almost all of those tests for ten or more towns in our vicinity. By reason of doing the Board of Health work we have also developed quite a business in other laboratory work for the physicians in all of these cities. It has been very interesting to see how the work has developed, and how in the smaller towns, even villages of small size, the work has grown, and the interest that the men have taken in getting all the help that is possible from the laboratory

standpoint. Recently we have added still further upon the chemical side of the laboratory, so that we make all the laboratory tests which might be desired in a medical way, in medical chemistry, and also commercial chemical analyses. But the main part of the laboratory work has always been on the medical line, and as I say, it has grown very much, from doing work for Springfield to doing it for a large number of towns and very small towns.

THE PRESIDENT. The next paper of the afternoon is a paper by Prof. James O. Jordan of Boston, " Observations on the Present-Day Milk Situation." I have the pleasure of presenting Professor Jordan.

OBSERVATIONS ON THE PRESENT-DAY MILK SITUATION

By PROF. JAMES O. JORDAN
Inspector of Milk, Boston, Mass.

It has been previously observed that there was popular prejudice against increasing the price of milk, and no better illustration of that statement could be found than the recent agitation which has been filling columns of newspaper space. Prices of other commodities may soar almost without protest; in fact, during this milk controversy the very papers which have given the most attention to the question have announced substantial advances in the prices of flour and beef, but beyond mention of these increases no further notice was given the subject. Yet these commodities are household necessities, and the advances are of great importance to purchasers; but no journalistic furor followed either in the

editorial or news sense. There was no attempt on the part of the press to protect or protest in behalf of consumers. Meanwhile the efforts of the newspaper artists and writers were turned upon the milk situation to such an extent that ordinary phases of the subject were early exhausted, and then began a scramble for ideas with a semblance of newness until even the reportorial staff had more than a surfeit of milk assignments and craved a change. So it is safe to conclude that an advance in the price of milk is likely to meet opposition from the newspapers if not from consumers, while advances in the prices of other necessities are likely to be accepted with little or no protest. The recent attitude of the press is to be deplored, because valuable space has been devoted to a side of the question from which the public will receive little or no substantial benefit, and at the same time prejudice inimical even to sanitary milk supplies — from the price standpoint — has been unconsciously engendered. Would it not have been more beneficial if the columns of newspaper space — wasted upon the price question — had been devoted to educating the public to the advantage of and substantial gain from the use of clean milk? The necessity for exploiting this subject upon an educational basis is apparent, and if this feature had been presented with as much energy and determination as that given to the cry for eight-cent milk, more New Englanders would now be demanding and securing the ideal variety than is the case at present. That would have been a praiseworthy attitude and of lasting benefit. But while the newspapers have not considered the subject from the standpoint of the best interest of the consumer, there are indications that it may bring about one permanent change, namely, a desire to end the semiannual bickerings over the price question. It is to be hoped that we have witnessed the last controversy of this kind, and that it will be possible in the future to adjust prices upon some new basis. While

these differences exist, high ideals in milk production or handling will be unattainable. A unanimity of interests is a necessity; until this condition prevails permanent gains are beyond reach. It is not the province of this paper to take issue with either side in this present price controversy, but the public and press — for a fair consideration of the issue — should not be unmindful of the fact that neither the production nor sale of milk are such alluring propositions as to invite the serious attention of capitalists. In view of this fact, is it not fair to assume that there are other callings which appear more remunerative for the investor? The public should know that the producing end of the milk business, outside of the present financial claims, means endless care and attention, that the milking of cows and oversight of product is necessary twice a day, every day in the year, Sundays and holidays included. Is not a situation like this, involving constant labor, worthy of serious consideration by the public? Do the press and public give due weight from the standpoint of the dealer — milkman — to a side of this price problem for which the consumers alone are blamable; namely, losses by bad bills and non-return of milk containers, cans and bottles, the latter either from motives of theft, carelessness or willful destruction? Remove these unnecessary and constant losses and the sale of milk will be established upon a more satisfactory basis. Yet these shortcomings of some consumers have an important bearing upon the price of milk, for the losses have to be at least partially borne by those who pay their bills.

While high prices do not necessarily mean clean milk, it is certain that milk produced under careful conditions cannot be secured for any considerable period at a low figure. Consequently those who desire clean milk must be willing to pay for it. But clean milk, regardless of price, is the cheapest variety to purchase.

Outside the price question, the public unfortunately is not earnestly interested in the milk problem. The quality even is not considered with enough seriousness to cause many consumers to go to a slight personal inconvenience to ascertain the facts concerning their supplies. The experience of the Bureau of Milk Inspection of the city of Boston supports this contention, for although the consumers in that city have been for years invited to avail themselves of the opportunity of having their supplies examined free of charge, not in recent years have enough purchasers taken advantage of this offer to average one sample per day; and this in a city having a population of over 600,000. Because of this lack of interest on the part of the consumer, is not the education of the public to the advantages accruing from the use of clean milk the greatest problem of all? And why is this latter classed as the most difficult feature? Because it means money; it reaches the pocketbook of the consumer, the one most deeply concerned, and at the same time most blamable for existing conditions. It is certain that until the public is brought to the point of demanding clean milk and being willing to pay for it, general supplies of this type of milk will be unobtainable. States may pass laws, boards of health may adopt regulations governing the milk traffic, and officials may enforce them,— as is now being generally done and more extensively than ever before in the attempt to bring about improvements,— but while laws and regulations may insure sanitary surroundings for all milk produced, they unfortunately do not guarantee that any milk will be raised at all. It would be as sensible to attempt to legislate that gold should be sold at the price of scrap iron, as to assume that legislation will give us clean milk while we are purchasing that commodity upon a dirty milk basis. Legislation is a great lever and is a necessary part of the cleaning-up programme, but laws can only partially solve the problem; beyond that point we must look to education

and enlightenment to complete the work. In fact, without adequate financial return for dairymen, it is a foregone conclusion that too stringent regulations demanding cleanliness will force many from the business. The latter are only human and they will do what others would do, if business was being carried on at a loss, or at least where a new dollar was not being returned for an old one, namely, abandon the production of milk. That condition already confronts us, for within the last year many farmers have ceased, for one reason or another, to produce milk. It is true that some of these men were ill fitted to engage in this traffic, but others have discontinued raising milk from financial reasons, and several of these were Massachusetts farmers and so located as to insure a product for Boston of medium freshness. All of this complicates the situation, as it means not only a possible shortage, but in any event milk from localities more remote from the consumer. In the usual conduct of the business this results in stale milk, a deplorable and usually unsatisfactory condition, but one which is at the present time unfortunately accepted as a necessity to supplies for the inhabitants of large cities. The tendency of this age is for those engaged in the milk traffic to seek at least a portion of their product from new localities, usually far removed from the consumer. This has an additional disadvantage beside that of the probability of a stale supply; namely, that the work of farm inspection has to be taken up anew in each territory, and it is not too much to assume that many of the new producers are ill equipped, either from the standpoint of temperament, or knowledge, or facilities, or all three combined, for the production of a high-grade milk. Thus there is a likelihood of a temporary return to old conditions, the time of duration lasting at least until the authorities or wholesale firms seek to have the farmer raise his milk somewhat in accordance with modern requirements. This is not infrequently a long process; meanwhile

quality suffers. The result then of the acquirement of new fields for milk supplies is detrimental in every respect, as it means ordinarily a loss to both consumer and contractor of older and near-by territory where some of the producers had the skill, intent, desire and facilities for producing milk of the commendable type.

The situation here is not so difficult or complicated but what, by slight changes in the method of conducting the business, much benefit would accrue. While fresh milk does not mean clean milk, no one can dispute that the fresh article is to be preferred to that which has had the experience of age. It cannot be maintained even that a clean brand of milk will improve by keeping, then what can be said of the existing condition by which no inconsiderable portion of our milk is delivered at the age of forty-eight, sixty and even seventy-two hours? Such aging might even imperil the quality of clean milk, and it is not difficult to conceive the influence of this ripening process upon much of the milk produced under the now existing conditions.

Boston and its surrounding cities and towns are in a milk-producting section of the country, and the population of these cities and towns is not so tremendous as to preclude the inhabitants receiving a supply of greater freshness than that now delivered. That it is possible to obtain milk of less staleness than that of the present day cannot be successfully disputed; but to bring about this important change two conditions are essential: one is that the consumer demand it to the extent of willingness to bear his share of the financial burden, and the other is that producers near by these cities and towns receive the proper stimulus and encouragement, not only to engage, but to continue in the production of milk. Thus all concerned — namely, consumer, producer and dealer — derive the benefit from having and being certain of supplies from the same producers.

There is ample territory not too far removed from these milk-consuming centers for the production of an abundant supply of milk, not only for the present but for years to come. It should be utilized for this purpose, and it would and will be if the right inducement is offered. And this inducement is, of course, a financial one; but that incentive ought to be sufficient, not only to give the producer a fair return on his invested capital, but to instill within him sufficient interest and progressiveness to produce his product under the best conditions, and a desire to remain in the business of raising milk. Then there will be co-operation, not only with the authorities, but with consumers and dealers. Conditions should be such as to develop competition among producers. This state of affairs governs other farm products, as it will that of milk when the quality idea predominates and the farmer receives satisfactory financial return for outlay and labor. Producers should receive and are justly entitled to the fullest financial encouragement. Neglect of the producing end of the milk traffic plays havoc with quality. Words cannot overestimate the importance of having milk leave the producer under the right and commendable conditions, and while it is not difficult to spoil good milk so produced, it is an impossibility to subsequently renovate milk previously impaired at the farm.

Is not milk one commodity where price should not be regulated by supply and demand? Are not quality and cleanliness the prime factors for fixing prices for this class of food?

Now what could be included under territory not too remote from Boston and its near-by cities and towns to insure a fresh supply of milk? Farms within 100 to 150 miles of Boston. Within this area there is sufficient acreage to furnish fresh milk to consumers, not only now but for a considerable period to come.

Milk from these farms should be produced under sanitary conditions, and cooled to below 50° F. at least within one

hour of milking. The cans in which the milk is to be shipped should be scrupulously clean, and even though the cans may have been returned by the contractor as "clean," if any doubt exists as to their condition that doubt should be removed by the cans being made clean by the dairyman before they are filled with milk. There should be no shirking of responsibility by those answerable for public milk supplies. The milk, the product of the morning and evening, should be taken to the station in the evening and there placed upon express milk trains composed of specially constructed milk refrigerator cars. The type of car which has been used in the past for transporting milk to Boston, and is now employed to a large extent, is antiquated and should be supplanted by the new-style milk car of the present day. One Boston firm is already operating a number of these cars. One of these cars, not including platforms, is 48 feet long to the outside of the sills. The inside measurement is approximately 8 feet 6 inches wide and 7 feet 6 inches high. This car is insulated as follows: there is an outside $\frac{7}{8}$-inch sheathing; then a 4-inch air space; then a 1-inch air space, and finally another $\frac{7}{8}$-inch sheathing. This provides insulation $7\frac{1}{8}$ inches thick. The roof construction is similar to that of the walls, with the addition that the monitor, which is 3 feet across and 18 inches deep, is sheathed in. The floor is $2\frac{7}{8}$ inches in thickness, being constructed of 2-inch plank, over which is laid $\frac{7}{8}$-inch floor boards. The car has one tightly fitting refrigerator door in the center on each side, in addition to the two end doors.

A car of the old pattern has an office in the center for the accommodation of the men in charge, and in cold weather this office is heated. The ends of the car are reserved for milk, and there are four closets in each end of the car. When the closets are filled the floor space outside is utilized for storage of milk. Each end of this car has four doors, one on each side (both sliding doors), and one end door leading

to the platform, and another door leading to the office. This gives eight doors per car to four doors for the new-style car. The end doors in the old type of car are frequently opened and afford an opportunity to go through the train. Thus air may be admitted from the end door to the parts of the car in which the milk is kept, and it is claimed that the sliding, poorly fitting side doors permitted air to be drawn in which increased the temperature of the milk in the summer, and in winter caused unnecessary freezing. Little or no attempt is given to insulation in the old cars, and they are not adaptable to ready cleansing.

The end doors of the new-style car are not used for passing through the train, for the reason that the car floor is covered with milk cans, and across the ends of the car there are shelves in which milk is placed.

There can be little doubt that in the new-style car, milk can be kept cooler than in the old-type car and at a less expenditure for ice. Actual use demonstrates that the refrigerator car can be loaded and unloaded more quickly than cars of the old pattern, and in addition the refrigerator car can be thoroughly and quickly washed with a hose.

While the refrigerator car is not a panacea for all of the evils attendant upon the production and sale of milk, its employment is advantageous, as it insures transportation of milk under improved as well as less expensive conditions.

It has been said that Boston's transportation facilities are entirely inadequate, and this assertion is true in respect to the carrying of milk. Slow trains are the rule, and some of Boston's milk is brought the whole or a part of the distance from the country upon mixed trains; furthermore, the trains often arrive late. Milk, although freight, should not be treated as such; it should be forwarded to consumers with express speed. The swiftly moving trains which have gathered the above morning and evening milk should arrive in Boston the same night; upon arrival the milk should be

immediately placed in bottles or cans, then loaded upon wagons and subsequently delivered to consumers in time for breakfast; this method of procedure to govern the regular and ordinary supplies of consumers.

Now this plan, although revolutionary and will meet with opposition, is feasible if approached in the right manner and spirit, and could be brought about at not a great expense over that of prevailing methods. Once in operation, it would entail less complaint from consumers and prove more satisfactory to dealers, because of decrease of amount of stale and sour milk. It would also lessen the quantity of ice required and practically eliminate the cost of storage. To the consumer the benefit from a fresh milk supply, half of which is twenty-four hours old and the other half only twelve hours old, would be substantial. But is the consumer ready to demand milk of this type, is he willing to bear his share of the financial burden and thereby enhance materially the value of his purchase, is he willing to forego the cream line upon his bottled milk, even though the milk be of equal richness? If so, and he is in earnest, the conditions are his for the asking.

Such a plan would do away with many of the troubles resulting from an old milk supply, and that is no inconsiderable portion of the difficulty. This idea is not advanced as an idealistic method, but as a means of providing a large community with fresh milk of fair quality, at a slight advance over ordinary prices

THE PRESIDENT. Dr. Norris, you have had some experience with this matter as a local health officer. We shall be glad to hear from you about the matter.

DR. NORRIS. Mr. President, I have been very much interested in Mr. Jordan's propositions, and although he stigmatizes them as revolutionary, it seems as though they were just the things that the consumers of the metropolitan

district have a right to demand. With more or less ill grace we have submitted to an increase in the price of milk produced largely under the standards that have existed for a few years. Now with the added price in their hands, it seems as though we should turn about and demand the quality standard which has been described so carefully by Mr. Jordan. The zone from which the milk is at present derived is one ever reaching farther and farther from Boston, and it seems to me that the time should come when a second wave should start out from the city and a zone that appears to-day more or less desolate over large areas, within forty miles of Boston, should be stimulated and given its just deserts, since from its geographical position it should be able to give us a large part of the fresh and clean supply we want.

DR. HASTINGS. Mr. President, I am sure we are all interested in what is being done, might be done, will be done, for the metropolitan district of Boston, but it occurs to me that perhaps the members here may be interested to know a little as to what a local district can do if it will for the betterment of its milk supply. Last spring the Norfolk District Medical Society at one of its meetings discussed the milk question to some degree. That includes the town of Brookline, part of Boston (through Roxbury and Dorchester), Milton, Dedham and off through that way into Norfolk County. As a result of that discussion a committee was appointed to see whether anything could be done to better the milk supply, or, rather, to find out who were furnishing the best milk supply, fresh milk supply, for that district. The committee reported that we could find out if we would who were the milkmen in that district who were furnishing good milk, or who were trying to furnish good fresh milk, out through that portion of Boston and the suburbs.

A commission was appointed, of which I chance to be secretary, and one of the members of the society, also a

member of this Association, Dr. Wardwell, was willing to undertake the inspection of the milk supply so far as we could go. Now that was just a start. Since that time he has been able to cover perhaps 150 of those who are furnishing milk to that portion of the state, with some assistance by the other members of the commission. We have been able to report to our Norfolk District twice, once in August, once only a few days ago, the first list being revised in the second statement. Our effort has been to furnish to the doctors in our district a list of farmers, of producers, or of contractors in a certain few cases, who are making an effort to furnish reasonably clean milk. Some of you hear a good deal about "certified milk." Dr. Norris is very much interested in "certified milk"; so am I. Dr. Morse in Boston is very much interested in "certified milk." Certain other specialists in that line of work are very much interested in "certified milk," meaning by that a milk that is produced under absolutely ideal surroundings and methods, and which has a very low bacterial count. Boston (the Suffolk District) makes it 10,000 per c. c. and I think Cambridge is the same. They insist that the milk producer shall meet all their requirements all the time, and there are not many milk producers that will do it. I think Cambridge has one, and Boston (Suffolk District) has one, the "Warelands."

It produces 300 quarts daily, a very inconsiderable amount, you will see, for that which might be needed. The Cambridge farm produces 1,000 quarts daily. Now it seemed to us that while that is ideal and a splendid thing for an example, as Dr. Morse said only a few days ago at the medical meeting where he reported, that it was not what we practically wanted. What we as doctors wanted to know was what farmers or what producers are putting reasonably clean milk into our hands. Where can we turn if we want real good milk for a baby and say, "If you get of that producer you may be pretty sure that you are getting good clean milk"? Dr.

Harrington of the State Board of Health approved our position, as did Dr. Durgin also. Professor Jordan has helped us very materially in showing that certain farmers are, certain others are not, doing what they ought from the bacterial point of view. In the last list that we gave to our members there are sixteen included. We tried to get at the larger producers so far as we could, because it was of more practical value to our constituents, to our doctors, to know some reasonably large producers, if possible. Dr. Norris has spoken about there being few producers near Boston, but taking Brookline, for instance, we find that there are 250 different firms or individuals bringing milk into Brookline. For our inspector or any series of inspectors to go over all of those in a very limited length of time you will see is quite impossible, but it was possible for us to notify the Brookline doctors that there are half a dozen who we are willing to say are furnishing reasonably clean milk.

Now that is a thing that I believe the other districts in the state can do, if they will. Other towns, other cities, can do it if they will, without much expense, if they can get hold of somebody who is interested in the subject, as Dr. Wardwell is, and who will be doing as he is doing, as we think we are doing, a real service to the community in being able to tell the doctors who are producing the best milk in that community. We do not make any negative statements, "so and so" is on the list, others are not on the list, and they may find out why if they want to, but we do not intend to make any negative statements by saying that "so and so is producing bad milk." That may or may not be true. It may be that an inspection has been made of that farm, it may be that it has not. But you will see that out of 150 we found only sixteen to be producing or trying to produce what we are willing to call inspected or reasonably clean milk.

I thought possibly, as this topic came up here, that it would interest you to know what one district medical society

is trying to do, and what it has done; perhaps others may through the State do something of the same sort. If we only will, we can convince the farmers outside that it is worth their while to be clean. They have to get their money, as Professor Jordan has said. They have not made much money, as those of us who live out in those regions or go out there through the year know, and we must pay more for it in towns and in the cities if we want the real, good, clean milk. We believe we do want it, as medical men, and the farmers are going to furnish it when they can be persuaded that customers will pay a little extra for extra cleanliness and care.

THE PRESIDENT. I wish there were some other gentlemen present who could repeat the capital statement which Dr. Hastings has made to us. Failing that, I hope we may hear from some of the gentlemen who are responsible for the production of milk.

MR. GEORGE H. ELLIS. Mr. President, I am of course thoroughly in sympathy with Dr. Jordan's paper, but approaching the matter, as I do, from the producer's standpoint, I feel perhaps more keenly than he does the necessity for the higher price for milk. Without taking any side of the present controversy, — I know nothing as to the inside merits of that case, — I do know that the farmers of this country cannot produce milk such as should be supplied in the city of Boston at less than, nor ought they to be asked to supply it for, forty cents a can. I have no hesitation in saying that as a matter of fact.

In my own case I have undertaken to produce milk on a somewhat large scale, it might almost be called on the factory plan, — manufacturing milk. It is not in any sense a side issue; it is our business at the farm. We are trying to produce sanitary milk; not certified milk, because when you come to the matter of supplying so-called certified milk you have got to limit the output very materially. It cannot

be done at what most people would call a reasonable figure. The cost of bringing your bacteria content to below 10,000 to the c. c., and being absolutely sure that you can keep it there, is so great that certified milk cannot be produced and sold for less than from fifteen to twenty cents a quart, which will appeal to a very limited constituency. That is satisfactorily proved by the experience of the few who have tried it here, and as satisfactorily by those who are trying it in other states. There is not any question about that.

We are trying to produce a sanitary milk, and we frequently go below the 10,000; but to insure under all circumstances keeping below requires care and cost, heavy cost. I was a short time ago at Mr. Hazard's farm near Syracuse, N.Y. He furnishes certified milk which is sold in Brooklyn. They told me there that a windy day, with the windows open in their sanitary barns, would quadruple the bacteria content, however much care they would use.

I am perfectly willing to give a few facts from my own experience. I started to sell milk at eight cents a quart in the city of Newton, retailing milk directly from the cows and handling it in what we should say is a sanitary way. As time has gone on, I have been absolutely obliged as a business matter to raise that price, first to nine, then to ten, and now to eleven cents, and I cannot do business on that basis for any less money. And yet the papers are complaining because the price of milk is to be raised but one cent per quart.

The quality of milk in Boston, I think Professor Jordan will agree, has increased within the past few years much out of proportion to the cost of that milk, or, rather, to the selling price, through the efforts of his office, but the farmers are not getting a fair price. I am not criticising the contractors, the gentlemen who sit here. I presume they find the difficulty just as most of us do. The people have not yet been educated up to paying the price for the milk, and that

is where the education has first got to come in. Good milk, — I venture this statement, — milk such as you gentlemen would like to see supplied in the city of Boston, coming from the country as it does and through the hands of the contractors, cannot be sold in the city of Boston at less than ten cents per quart and return a proper amount to the producer. It simply cannot be done. In order to give you the milk that you want, and insure the quality that you want, the producer must have his fifty cents a can, and that means at least ten cents a quart retail in Boston.

It is fair to say that a part of the expense in my case — that ought not to be taken perhaps in the arbitrary way that I have stated it — comes in because we are furnishing a milk much higher in butter fat than is required by any standard, and higher than many people perhaps would be ready to pay for, our standard being five per cent. That accounts for a part of the increased cost to us, not merely that we are trying to manufacture the sanitary milk. That is, you might say, a matter of fancy, whether a man cares to pay for a five per cent butter fat or will take the Massachusetts standard. But that is another question.

The education has got to — well, I guess the place to begin educating is with the reporters on the newspapers. I don't myself believe that the people in this city begin to care about the increased price for milk as the reporters have made it appear. They have undertaken to create public sentiment against the producers and against the contractors and against the retailers, and they have succeeded to a very large extent; but they have not succeeded to the extent that might appear. I think that the very agitation itself has helped somewhat, for, again speaking from my own experience, when I have increased the price of milk before — and I am not now undertaking to advertise my business, I simply wish to state the facts — I have lost a considerable percentage of customers, and this time the increase from ten to eleven

cents has resulted in almost no loss at all. The people have accepted the situation. To that extent the newspapers have helped by their agitation to call attention to the increased and increasing cost. They have not put it in that way, but I think the common-sense housekeeper looks at it something as she would when she goes into the store and sees there the placards "Eggs," "Fresh Eggs," and "Strictly Fresh Eggs." She expects to pay a higher price for the "Strictly Fresh Eggs" than she does for the "Eggs," and if she buys the "Eggs" she does not expect to get anything like "Strictly Fresh Eggs." I do think that this agitation has helped to call public attention to the fact that there is a difference in milk, and they don't seem to have realized it heretofore. They have said "milk is milk," and the sooner we can educate them to understand something else the better.

MR. GRAUSTEIN. I think one trouble has been that we never have given the public and the consumers the facts as to what it costs to deliver a quart of milk. I have spent considerable time estimating the cost of delivering a quart of milk from the bottling room in Boston to the consumer. I want to draw your attention to the fact that forty-one different items enter into the cost of delivering a quart of milk. Just the bare expenses, without cost of overseeing, interest on money, or anything for accident, amount to 3.21 cents a quart to deliver a quart of milk from the bottling room to the consumer. If I had each item here I think you would agree with me that we could not dispense with one, and you would also agree that my figures are at least ten per cent too low on every item, if not more. There is more than one-third of the nine cents a quart that the milkmen, the retail milkmen, ask the consumer. You can readily see that, if it costs this much to deliver a quart of milk, what it must take to bring a quart of milk from the country to the bottling room; and what is there left for the producer? I am satis-

fied that neither the producer, the contractor nor the peddler has been or is receiving sufficient pay for the work that he does.

Those are facts that cannot be disputed, and I for one am ready to furnish all the evidence required to any disinterested board. I know that the other contractors will not agree with me on my figure of what I say it costs from the bottling room to the consumer, but I am willing to furnish them figures to show that it at least costs that and more. That is one of the reasons why we cannot produce a better article of milk for the consumer than we have, because you have not paid enough for it. In these items there is nothing for cans, which are always furnished by the contractor, and there is nothing for freight; as to the average cost of bringing a can of milk into the city of Boston it costs me 4.23 cents per can of eight quarts.

THE PRESIDENT. Mr. Whiting, we should be glad to hear from you on this matter.

MR. GEORGE WHITING. Mr. Chairman and Gentlemen: There could not be anybody more interested in this subject than I. I thought after Professor Jordan had read his paper that he had told about all there was to the question, but I found there was a little more when Mr. Ellis gave his side of it. Mr. Ellis's case seems to be rather different from that of anybody else in that he produces a superior quality of milk. He is rather in a class by himself. As the cost of production of milk increases it does not matter whether you make it excessively rich in butter fat or of a poorer quality. The cost of production goes up in Mr. Ellis's case the same as it does in that of the ordinary producer, so that Mr. Ellis and others who have touched on this point have not put it any too strongly that the price which was established in Boston on October 1, of this year, which is one cent per quart advance over what it has been in previous years, is not great enough.

But I feel that this subject has been enlarged upon rather more than was intended. I hardly think this is a meeting where you care to bring in the cost particularly or to dwell upon the present agitation that the newspapers seem to be working on so diligently. You will notice, however, that we have had very little to say in the matter, because we felt that those who gave this matter to the newspapers were shooting so wide of the mark that it was not worth while for us to make any reply, which course we have pursued up to the present time.

I think that something more specific should be said about that part of the subject which interests you as members of this Board. You are interested to know about the sanitary conditions, to know just what is being done in that line by the larger contractors who handle the milk. I made a statement a few meetings ago that we were subjected to great cost in inspecting our milk, both chemically and bacteriologically, and that we have now in our concern alone three inspectors who go about the country doing nothing else but looking after the conditions at the farms, and this we think is right in accordance with what your Board desires. Statements have been made in the papers that Massachusetts milk is superior to New Hampshire milk or milk in adjacent states. This is not a fact, for we realize that milk will not be accepted from other states, any more than from Massachusetts, if it does not come up to the requirements; so whether we would or not, we bring milk in here under the same inspection from other states as from Massachusetts. The bacteriological count, I am very certain Professor Jordan or anybody who knows about the subject would tell you, is as low in milk from some other states as from Massachusetts. We are keenly alive to the matter af sanitation and are sparing no pains or money to put milk into this market which is a credit to it. We are for a high standard of milk because we believe that that is what the consumers of Boston want.

If the standard is lowered we believe that very soon cows will be put into the herds that will not produce milk any higher than that standard. As somebody said at one of the hearings before the Agricultural Board last winter, the people of Massachusetts want something a little better than those of other states, and we are doing our utmost toward maintaining the very high standard which has always prevailed in this state, both for milk and other food products.

I believe, as Professor Jordan said, that there are a good many reforms to be made and new methods to be introduced. Perhaps the old milk car should be put out of commission. We are operating cars to-day that are fitted up as refrigerator cars in which the temperature can be kept at a very low point. Professor Jordan tells us that if we do not bring milk into this market of a certain temperature we are liable to annoyance and prosecution, so on this ground, if for no other reason, is it for our interest to use that car which is the best adapted for shipping milk.

I do not agree with Dr. Norris that sufficient milk can be produced within forty or fifty miles of Boston for this market. As I have stated previously before this Board, farming is being taken up by fancy farmers, by men who do not care to produce milk and who, as a matter of fact, cannot afford to put their time into this business. Such places as Lincoln and Concord are producing little milk at this time as compared with twenty-five years ago. There were at that time about four cars of milk taken from Concord, Bedford and Lexington where to-day there is practically no milk put on the cars, and I hardly think there is any more wagon milk coming in than there used to be; so I say we cannot expect to have milk produced within fifty miles of Boston in sufficient quantity to take care of this market. We are now obliged to go 150 miles from Boston for milk, and there is no more difficulty in getting it into Boston in

good condition from this distance now than there was twenty-five years ago from a distance of fifty miles.

We are heartily in sympathy with every action which your Board is making in requiring sanitary milk, and we are leaving no stone unturned to do our part in co-operating with you.

MR. RICHARDSON. If the reporters will confer with boards of health, with milk inspectors and with sanitary inspectors, they will be given facts and figures which they can publish in their public organs, the newspapers, which will be of benefit to the people, also to the boards of health, who have this question to contend with. I hope from what they have heard here that they will avail themselves of the privilege of consulting with those that know.

THE PRESIDENT. Does anything occur to you, Mrs. Richards, to add to this interesting question? You are a veteran in this matter.

MRS. RICHARDS. Mr. President, I think the education of the people is of the greatest importance, and I believe if more country laboratories, that we heard about in the first paper, were established, and more effort was made to show the public the actual reasons for these things, we should get much nearer the question. It seems to me, as I think I have said before, Mr. Chairman, that this whole sanitary matter is a question of education. The question of getting milk which is of proper quality for the children is one of the things which should be carried on in an impartial way, and I believe that the thing should come from the citizens' side as well, perhaps more readily than from the boards of health. If the boards of health in every locality would furnish the information, and then some civic association or something of that kind would scatter the right knowledge among the people by meetings, and lectures, and exhibits like the tuberculosis exhibit, or whatever we can have in that way, I think we should get *at the people*, but I do not believe we shall reach them from either side by mere general

outside discussion by people who do not understand the problem. The great question is one of sanitary importance, that is, the question of health, of saving the lives of the children and saving the health of the grown people and invalids who use the milk. We should not lose sight of that one thing, the value of human life. I suppose there is no other article of food that we consume the quality of which affects so many people as milk. I do not believe there is any article of food about the purity of which we have heard so much for the last few years, which really means so much to the community, as the milk and its cleanly quality.

DR. MILLER. Mr. President, it seems to me that, taking a sanitary point of view, we have got to pay the milk producer more. Now it costs the producer a great deal more than it did a year or two ago. I was talking only a few days since with a business man in Natick, who is dealing in this subject to quite an extent, and he said that the labor unions had interfered with his business so that he had to employ two men, or nearly two men, now to do the work of one man, consequently it cost him a great deal more. I know some men in Needham who have, for the past few years, been in the habit of buying standing grass, cutting and selling the hay. This year they have not done it, because they said they could not get the help to cut the hay. Consequently the price of hay is very much higher, the price of labor is higher, and I don't see how the producer can produce milk unless we give him a better price for it.

MR. UNDERWOOD. Might I add just a word? It seems to me that our local boards of health might do excellent work along the line that Mrs. Richards has suggested by explaining to the people some of the reasons why milk has gone up in price, one of the principal reasons being the increased cost to the producer, to enable him to deliver milk that shall come up to our sanitary requirements.

In our town, Belmont, during the past year, our Board of Health has issued a pamphlet entitled "The Production and Care of Clean Milk." This pamphlet has been sent to all our milk producers and has also been printed in our Town Report, which reaches every taxpayer in the town. It explains why it is necessary to keep the cows clean and observe care when they are being milked; to keep the stable clean and to have plenty of light and good air; and why it is necessary to cool the milk as soon as it has been milked and keep it cool until delivered.

The pamphlet also describes a number of experiments which were made by our bacteriologist, showing the common causes of bacterial contamination of milk and explaining why under some conditions the bacteria may increase enormously. All these things are told in a simple way, and we have already seen many good results from it. The milk producers are co-operating and doing all they can towards making the conditions better. It seems to me that the boards of health might do good work in this way by informing the people, as well as the milk producers, why it is necessary that so much care should be taken with our milk supply.

THE PRESIDENT. The next thing on your programme is the miscellaneous business of the Association. Is there anything which any member desires to bring forward at this time?

PROFESSOR JORDAN. Mr. President, Dr. Hanson has unfortunately been called away, and he has asked me to propose for him an amendment to the constitution. He desires the name of the Association changed from the present name to the Massachusetts Public Health Association. He has already had correspondence with a number of the members of the Association, and the greater portion have agreed that the change is desirable. I make that motion on his behalf.

THE PRESIDENT. Under the by-laws of the society the amendment will be received and acted upon at the next meeting, notice thereof being given to the members. Is there any other business?

On motion, the Association adjourned.

BIOLOGICAL LABORATORY NOTES

By FREDERIC P. GORHAM

Associate Professor of Biology, Brown University, and Bacteriologist, Providence Health Department

THE NEPHELOMETER, an instrument for the estimation of the number of bacteria in suspensions used for calculating the opsonic index and for vaccines, is described by Joseph McFarland in the Journal of the American Medical Association for Oct. 5, 1907.

A USEFUL MODIFICATION OF LOEFFLER'S BLOOD SERUM is recommended by Buchanan.* It consists of the addition of neutral red as an indicator in the proportion of 1:10,000. On this medium the meningococcus thrives well and assumes a pink color, so that the colonies may be easily detected.

PERMANENT STAINED PREPARATIONS. Those who wish to preserve stained slides of bacteria for future reference must remember that the ordinary anilin stains fade rapidly, however carefully they may be guarded from the light. The use of carbol-fuchsin, in such cases as it is applicable, will considerably prolong the life of such slides and in some cases may make them entirely permanent.

SPIROCHÆTA DENTIUM may be cultivated on horse-serum agar for several generations in symbiosis with a bacterium according to Mühlens.† The colonies show after

* Lancet, 1907, I, p. 1590.

† Central. Bakter. Erst. Ab., XXXIX, 1907, 479.

eight to ten days at 37° C. They are difficult to distinguish and appear as a yellow clouding of the serum agar. The organism may survive for four to six weeks.

NEGRI BODIES IN THE SALIVARY GLAND OF MAD DOGS. Stefanescu reports * that negri bodies may be demonstrated in frozen sections made from material fixed in formalin. They were stained twenty to thirty minutes by Mann's method (methylene blue and eosin) modified to suit the requirements of each case. The negri bodies by this method are stained red-violet, while the cytoplasm of the cells is blue.

GRANULAR FORMS OF THE DIPHTHERIA BACILLUS. In the routine examinations for the diagnosis of diphtheria in our own laboratory, and Mr. Rickards informs us that the same is true in the Boston Laboratory, the granular forms of the diphtheria bacillus have been exceptionally uncommon this fall. Their place is taken by the barred type, which have become now the most common form. Indeed there would hardly be a positive diagnosis at present were we to abide by the former rule to regard the granular types alone positive.

STAINING SPIRILLA IN SPUTUM. Follet recommends † the use of the following method for staining the spirilla ordinarily found in sputum. With a platinum needle select a small bit of freshly expectorated sputum, preferably after fasting, place on a slide and add thereto a minute drop of the following stain, mix thoroughly, put on a cover-glass and examine. Stain: glycerin, 40 gm.; acid fuchsin, 2 gm.; pure carbolic acid, 0.5 gm.; mix and filter. Double staining may be effected by using in addition to the acid fuchsin

* C. R. Soc. Biol., LXVII, 1907, 886.
† C. R. Soc. Biol., LXII, 1907, 567.

solution the following: glycerin, 40 gm.; methylene blue, 2 gm.; pure carbolic acid, 0.5 gm. This method stains all the spirilla of the mouth and there is no difficulty in recognizing the Treponema pallidum if it be present. Another method suitable for both fixed and fresh films consists in staining in the following: chloroform, 40 gm.; methylene blue, 2 gm.; acid fuchsin, 0.25 gm.; pure carbolic acid, 0.5 gm. The stained preparations must be thoroughly washed in running water and if need be in alcohol to remove the excess of stain.

SYNTHETIC CULTURE MEDIA. The increasing use of synthetic culture media indicates that the time is not far distant when we may hope to secure more definite knowledge of the food requirements and other points in the biochemistry of micro-organisms. We note the paper by Hadley* on "The Growth and Toxin Production of Bacillus Diphtheriæ upon Proteid-free Media," in which he found that the diphtheria bacillus would grow and produce its toxin upon the following:

Glycerin	3.40 parts
Sodium chloride	0.60 "
Calcium chloride	0.08 "
Magnesium sulphate	0.32 "
Di-potassium phosphate . .	0.23 "
Ammonium lactate	0.75 "
Glycocol	0.10 "
Distilled water to make . .	100.00 "

In our own laboratory it has been found that the colon bacillus will grow abundantly and quickly on the following:

Sodium or ammonium phosphate,	0.20 parts
Asparagin	1.00 "
Distilled water to make	100.00 "

* Jour. Inf. Dis., 1907, Suppl. No. 3, page 95.

In some cases ammonium lactate may be substituted for the asparagin.

Taltavall and Gies,* in "A Chemical Study of a Bacillus Causing Septicæmia in the Rabbit," made use of the following:

Di-potassium phosphate	0.20 parts
Potassium aspartate	0.40 "
Potassium lactate	0.60 "
Distilled water to make	100.00 "

Jordan, in "Experiments with Bacterial Enzymes,"† found that a large amount of gelatinase is formed by some bacteria in non-proteid media. In asparagin, 0.2 parts; sodium phosphate, 0.2; distilled water, 100.0 parts, *B. subtilis* grows well and produces gelatinase slowly. The addition of magnesium sulphate gave very similar results, but the substitution of a potassium for a sodium salt led to a negative result.

* N. Y. Med. Jour., LXXXVI, 1907, 723.

† Biological Studies by the pupils of William Thompson Sedgwick.

CHEMICAL LABORATORY NOTES

By FRANKLIN C. ROBINSON
Professor of Chemistry, Bowdoin College, Brunswick, Me.

FORMIC ACID AS A PRESERVATIVE. Formic acid has long been known to be a powerful antiseptic, and now it appears on the market for that purpose under the names of werderol, fructol, alaced, extract of nettles. It is especially used to preserve fruit juices; 1–1.3 grams of formic acid per 1,000 is sufficient for such preservation, and the above preparations contain from 11–50 per cent of the acid. It can be detected by diluting the fluid, acidifying with hydrochloric acid and distilling with current of steam, receiving the distillate in a solution of sodium hydrate, a weak solution. The distillate is evaporated to 10 c. c., treated with barium hydrate, filtered, the excess of barium removed by sulphuric acid, and the filtrate from this treated with mercuric chloride. Formic acid is shown by a precipitate given by the mercuric chloride.

TEST FOR ACETANILIDE IN HEADACHE POWDERS. Heat the substance for some minutes with moderately strong hydrochloric acid and, if acetanilide is present, aniline will be formed, and can be recognized by its odor, and by giving the precipitate with bromine water or sodium bromate. The test can be made quantitative by weighing the powder, and then after liberating the aniline, titrating with a hot solution of potassium bromate. The end point is a permanent yellow color.

ACTION OF BILE ON PNEUMOCOCCUS AND STREPTOCOCCUS MUCOSUS. Recent tests show that they are

destroyed by bile and also by the pure sodium taurocholate obtained from bile, but that other streptococci are not acted upon.

SUBLAMIN. This is a compound of mercuric sulphate and ethylendiamine. It is proposed as a substitute for bichloride of mercury; the superior claim for it is that it is not precipitated by albumin. Tests show that it is not less poisonous than the bichloride.

DRY POWDER FIRE EXTINGUISHERS. Most, if not all, of these are bicarbonates, generally of sodium, and what efficiency they have is supposed to come from the carbon dioxide which they give off when heated. As a matter of fact a fire has to be pretty well along before it is hot enough to decompose enough sodium bicarbonate to be of much value as an extinguisher, and on a small fire they merely act mechanically, like any other inert non-inflammable substance, fine sand, for example.

ILLUMINATING GAS VS. ELECTRICITY. Mr. Vivian Lewis, writing in the *Progessive Age*, makes the claim, which is rather novel, that gas is superior to electricity for room lighting from a hygienic standpoint. He says that it is a fact that in a hall lighted by electricity an audience cannot remain in comfort for even an hour, while when it was lighted by gas they stayed in it for three hours without complaint. The explanation he offers is that, although gas flames add carbonic acid to the room, yet they burn up the organic matter given off in the breath, and this, and not carbonic acid, is the discomforting thing in such a room. His experiments seem to bear out his theory. Gas flames are also a help to the proper acting of all automatic systems of ventilation, while electric lights have little or no influence of that kind.

PERSONAL HYGIENE

By PERCY G. STILES, Ph.D.
Instructor in Physiology, Massachusetts Institute of Technology

BACTERIA OF THE INTESTINE. This is a subject which is constantly assuming greater importance for the student of personal hygiene. A notable book of the year is Dr. C. A. Herter's "Bacterial Infections of the Digestive Tract." The reader is at once impressed by the great number of recent studies in this field and by the growing recognition of the putrefactive organisms in the colon as a cause of many systemic disturbances. It has, of course, long been plain that mild symptons of toxæmia may result from undue bacterial action in the alimentary canal—such, for example, as headeache, drowsiness, and generial inertia. But it appears constantly more probable that other and more acute troubles may have a similar origin. Under this head may be included many cases of dyspepsia, rheumatism, anæmia and nervous disorders. The offending organisms are generally of an anaerobic type and the species and characters observed are fully dealt with by Dr. Herter. The conditions found in the small intestine rarely favor their growth, but too often they thrive in the colon.

Our present interest is in the means available for the restraint of these harmful bacteria. Metchnikoff and others have for some time advocated the practice of introducing large numbers of acid-producing organisms with the food, seeking thus to make the dominant type of bacterial action

in the intestine one which is inimical to the growth of putrefactive anaerobes. This has been variously accomplished, by the drinking of milk soured by pure cultures of acid-formers, by the more palatable modifications known as kephir and koumyss, and also by taking the organisms in tablet form (lactobacilline). The success of these methods has often been striking and is registered at the same time by the improvement in the patient's general condition and by the nearly complete disappearance from the urine of the telltale indican. The bacteria of the colon group are conceived to be in some degree defensive against the anaerobes.

If the putrefactive organisms are not to be kept in subjection by hostile forms, the alternative is to limit their food supply, and it is here that Dr. Herter's suggestions are most practical. To keep down the proteid residues in the large intestine it is obviously necessary to avoid overfeeding. In particular it is well to use little meat or milk. Gelatine may be substituted to some extent for proteid, as this albuminoid yields no aromatic decomposition products, and cannot give rise to indol or related bodies. Having made sure of a reasonable diet, the next object is to promote digestion and absorption in every possible way. A vicious cycle is very likely to be encountered, since intestinal putrefaction lowers the efficiency of the digestive apparatus, and the disordered digestion in turn leaves more material subject to putrefaction. Dr. Herter recognizes the great value of rest in restoring the impaired digestive power. Avoidance of fatigue and freedom from worry are probably more effective than the employment of pepsin preparations or intestinal antiseptics. The author does not recommend the extensive use of drugs of the latter class, holding that they must usually be toxic to the tissues as well as to the bacteria. Hydrochloric acid he thinks to be occasionally beneficial. Something may be accomplished by thorough washing out of the colon.

One is led to realize afresh how nearly useless the large intestine has come to be in the case of civilized man. Once a necessary organ of some ancestral creature, it is now a drawback and a menace to health. Metchnikoff has claimed that the poisons absorbed from this superfluous bowel bring on arterial sclerosis and hasten the advance of old age. The present work emphasizes similar possibilities for mischief. Dr. Herter believes that in cases of obstinate putrefactive activity with serious general effects it may be necessary to shorten the large intestine by a surgical operation. Loss of the whole colon, with the establishment of an opening near the end of the small intestine, has been more than once recorded. There was no failure of nutrition in such cases, but a complete suspension of putrefactive processes with inoffensive acid discharges. It is fair to add that Fletcher and some of his disciples appear to have secured a similar immunity from putrefaction by the well-known methods of the cult — a minimal diet well masticated.

MUNICIPAL SANITATION

CHARLES V. CHAPIN, M.D.
Superintendent of Health, Providence, R.I.

CONTROL OF MEASLES. Dr. Aberstaller * of Graz, a city of 175,000 inhabitants in Styria, does not believe in very stringent measures for the isolation of this disease, but he thinks that much may be accomplished by procedures which do not inflict very much hardship on any one. His chief attention is directed to school attendance. When measles develops in a family the well children are excluded from school unless they have previously had measles. The evidence of a previous attack is obtained from the records of the health department. This may be satisfactory in Graz, but with the defective registration of measles and with our shifting population the records in American cities are very incomplete. In Providence children who have had measles are allowed to go to school, and thus far I have found that it is in most instances possible to rely upon the statements of the family or of the attending physician as regards previous attacks. The Styrian Board of Health recommends that all children over twelve years of age, in measles families, be allowed in school, irrespective of whether they have had the disease. This is on the theory that nearly all children of that age are for one reason or another immune. Personally I am inclined to think that this position is well taken, but Aberstaller does not approve of it.

Most sanitary authorities close schools on account of measles only when a considerable number of cases have

* Public Health, August, 1907, page 691.

appeared. Quite a different procedure is followed in Graz. When a case of measles occurs in a school nothing is done for eight days, at about which time it is believed that any children who contracted the disease from the first case are likely to begin to show symptoms. The school is then closed and kept closed for about ten days, when it is assumed that all cases contracted from the initial case will have developed. Of course, all secondary cases are isolated at home, and the school is then opened for the other children. Dr. Aberstaller records 103 outbreaks during the last eight years treated in this way. In ninty-one instances only one class was closed, which I presume corresponds to the closure of a single room in an American school. "Of these prophylactic school closures, forty-four were attended by complete success, *i.e.*, absolute and lasting freedom from measles after reopening. In ten cases no secondary infection occurred during the closure, which may therefore be termed superfluous, while in twenty-eight cases the procedure had no apparent success, inasmuch as further cases resulted immediately afterwards. In the remaining twenty-one cases the result remained in doubt, as these classes were again attacked a little later by the epidemic which had meanwhile increased outside of the school."

Attention has previously been called in this Journal to the fact that the Department of Health of the City of New York in 1902 adopted very stringent regulations for the control of measles, insisting upon the isolation of the patient, rigid school exclusion and disinfection. Below are given the cases and deaths reported since 1898. As may be seen, there has been some decrease in the number of deaths, and an apparent great increase in the number of cases. This increase in cases is very likely due to better registration. Whether the decrease in deaths is due to restriction of the disease, that is, is a real decrease in the number of cases, or to a change in the character of the disease, or to a change

in the age distribution of the cases, it is impossible to tell from the report.

Year	Cases	Deaths
1898	9,916	651
1899	8,577	587
1900	10,698	816
1901	7,592	449
1902	11,645	710
1903	13,689	508
1904	32,861	895
1905	19,026	247

RESPONSIBILITY FOR THE REPORT OF BIRTHS. The Appellate Division of the Supreme Court of New York * rendered a decision May 13, 1904, in an action brought by the Department of Health against William W. Owen, that it was not sufficient for a physician to mail the return of a birth, but he must see to it that it was actually received by the Board of Health. From the fact that the Court stated that the physician may readily ascertain, by telephone, whether the return had been received, it would appear that it would be within the law to report the birth by telephone.

Since 1893 the Department of Health of the City of New York has acknowledged all reports of contagious disease, so that if a physician does not receive such acknowledgment he knows that his report has not reached the department.

TO STOP SPITTING IN CARS.† In Minneapolis whenever a person spits on the floor of a car the conductor is to give the spitter a red card on which is printed the ordinance. This somewhat conspicuous procedure is said to have had a marked deterrent effect.

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* 94 App. Div., 425.

† Report of Department of Health of Minneapolis, 1906, page 15.

PREVENTION OF INFANT MORTALITY. In order to prevent infant mortality by offering advice, furnishing a nurse, or supplying pure milk, it is highly important to begin early, hence it is desirable that every birth should be brought to the knowledge of the health officer as soon as possible. Very few laws require the immediate report of a birth, hence Dr. Pringle, the Medical Officer of Health of Ipswich, England,* offers one shilling to *any* person who first reports a birth within forty-eight hours.

VALUE OF REMOVAL TO THE HOSPITAL. It is a custom to attribute to contagious disease hospitals a high degree of utility in protecting the remaining members of the family by affording a suitable place to which the patient may be removed. It is very desirable to know exactly how much removal to the hospital really accomplishes in the way of affording such protection. Very few reliable data are available. Dr. Malet, of Wolverhampton, England,† states that of 7,766 susceptible children under eighteen years of age remaining in houses after removal of scarlet-fever patients to the hospital, 372, or 4.8 per cent, were subsequently attacked, while of 721 children in scarlet-fever families, where the patient did not go to the hospital, 179, or 24.8 per cent, were attacked subsequent to the first case. According to these figures the chance of other children in the family becoming infected when a case of scarlet fever is treated at home is nearly five times as great as when the initial case is removed to the hospital. It is highly desirable to have figures from other places, and to consider them with reference to the age distribution of the children, and the date of removal to the hospital.

* Public Health, September, 1907, page 741.
† Public Health, September, 1907, page 753.

SANITARY ENGINEERING NOTES

By ROBERT SPURR WESTON, Boston, Mass.
Assoc. M. Am. Soc. C. E.

EFFECT OF COPPER ON WATER BACTERIA.* The author's experiments show that harmless bacteria in water supplies are not appreciably affected by certain small doses of copper sulphate sufficient to kill the harmful kinds of bacteria. They further state that carbon dioxide lessens the destroying power of copper sulphate, but that it has no effect upon the bacteriacidal action of metallic copper.

The authors fail to state what the effect would be upon the other plant and animal life to which bacteriacidal doses of copper were added. Others' experience goes to show that fish are killed when copper is added to water in large doses.

The authors mention the use of copper sulphate in connection with water purification, and advise that in mechanical filtration of hard waters copper sulphate be added some hours before coagulation, since after the addition of sulphate of alumina a hydrate of copper and aluminum appears, which precipitates as under direct bacteriacidal action.

The authors state that where copper sulphate and iron sulphate are used together in the purification of water, the copper retains its toxic properties. The latter diminish, however, in the presence of carbon dioxide. When copper salts are used in connection with slow filtration plants they should be added to the effluent, otherwise the toxic effect is lessened.

* Kellerman and Beckwith, U.S. Bureau of Plant Industry, Bulletin No. 100, Part VII.

THE RECOVERY OF ALBUMINOID AMMONIA FROM DISTILLATES CONTAMINATED WITH PERMANGANATE.* Because the albuminoid ammonia test in water is often rendered useless as a result of alkaline permanganate going over into the distillate, Hale has suggested a method for its recovery, to be used only when a second portion of water is not available. In brief it is this. Reduce the permanganate by an alkaline sulphite solution, oxidize the manganous salt to the hydrated peroxide, filter off the manganese on a carefully washed filter paper, nesslerize the filtrate, and read in the usual manner.

CHICAGO DRAINAGE CANAL CASE.† A discussion of this famous case, in which the United States Supreme Court decided that the state of Missouri proved that St. Louis had not suffered because of the opening of the Chicago drainage canal. The discussion held at the meeting where numbers of experts from both sides took part is interesting but too long to abstract. It contains the latest ideas of the best experts on the pollution and self-purification of streams.

NEW SETTLING BASINS AT ST. LOUIS.‡ The present subsiding basins at St. Louis have been increased by two new basins each 400 feet wide by 800 feet long, and having an average depth of about 21 feet. In addition to the basins a new building for storage and application of the chemicals used as coagulant is being constructed.

SEWAGE DISPOSAL BY BIOLOGICAL PROCESSES.§ The author gives results based on his extended experience at Birmingham, England. "No matter by what method the tank is prepared for oxidation and nitrification on a

* F. E. Hale, Journal of American Chemical Society, XXIX, page 1085.
† Journal of American Water Works Association, 1906, pages 153–248.
‡ Engineering Record, 56, 13.
§ A. D. Watson, Engineering News, 58, 89; also Engineering Record, 59, 91.

biological filter, it is desirable that it should be rendered as free from suspended matter as possible." For this purpose the author employs special pyramidal tank with vertical walls rising in the form of a square. The velocity of the sewage entering the tank is from one to two feet a second. The average velocity in the tank is seven feet an hour. The sludge is drawn off from time to time from the apex of the pyramidal bottom. The cost of tank treatment is about forty cents a million gallons. The cost of burying sludge from the tank is about fifteen cents per million gallons. The cost of installation is about $2,530 per acre of bed supplied.

Biological filters should be on the percolating principle. The material should be supported on special tile underdrains in order to allow the free exit of all matter in suspension and to afford ample aeration. Any rough material will do for filtering, but it should be durable and the particles should approach a cubical shape to prevent their surfaces coming into too close contact. The smaller the particles the better the effluent, but perfect effluents should not be striven for, and a non-putrescible effluent is to be desired. The effluent should contain nearly as much suspended matter as the applied sewage. The distribution of sewage over the filter is most important. Conditions approaching falling rain are ideal. Better distribution effected by movable distributors is not worth the increased cost over fixed sprays, and the difference in efficiency is hardly noticeable. The suspended solids in percolating filter effluents amounted to from 70 to 80 parts per million and were removed by subsidence, at a cost of ten cents a million gallons. The article is accompanied by valuable tables showing in a very condensed form the results of operation of eleven experimental beds together with valuable cost data. Author advises caution in estimating the capacity of trickling filters. Beds six feet deep at Birmingham handle about 900,000 gallons of strong sewage per acre per diem with occasional doubling of the

rate for very short periods. The paper is commendable for the condensation of much valuable and practical information in small space.

OFFICIAL REPORT ON TYPHOID FEVER IN WASHINGTON, D.C., IN 1906.* This report was made by the officers of the United States Public Health and Marine Hospital service, and is the most comprehensive report ever made. The report followed an epidemic, which in turn followed the installation of new water filters at Washington. The commission debits ten per cent of the typhoid cases to the milk supply, fifteen per cent to importations, and six per cent to contact, leaving sixty-nine per cent unaccounted for. The disease reaches its height early in August. It is the impression of the members of the Board that fruit and vegetables, also shellfish and fresh-water fish had nothing to do with the epidemic. Bedside disinfection was found to be insufficient in the majority of cases. The milk supply is in a deplorable condition. Intestinal worms were not found in any of the two hundred cases selected at random for investigation. All the deep wells examined were of excellent quality, but about one-half of the shallow wells showed evidences of pollution, yet none of the cases of typhoid investigated were attributed to polluted well water. Much of the table water sold in Washington is suspicious. The water supply is from the Potomac River. Practically no direct pollution takes place within nineteen miles of the intake. The sewage of about 45,000 people drains into the river, indirectly for the most part. The dilution therefore is very great. Filters were installed in 1905 to treat the water after storage for about four and one-half days in the system of reservoirs constructed some years ago. Bacterial examination shows these filters to be sufficient, although B. coli was found in 66.6 per cent of the raw water samples and in

* Engineering News, 58, 44.

14.2 per cent of the filtered samples. It should be noted that the filters were designed to operate with the aid of a coagulant, but that the opposition of the public, the Medical Society in particular, has prevented the carrying out of the original plans. The article states the points in favor and against the view that the Potomac River plays an important part in the dissemination of typhoid fever in Washington, but the commission is unable to give a definite answer to this question. Neither is it able to show that the water is an important cause of the typhoid. Typhoid fever in Washington is mainly a summer disease, and is especially prevalent among the colored population. Mention is made of the fact that Winnipeg, with the artesian well supply of exceptional purity, has a death rate of more than double that of Washington, but the report failed to state that the epidemics at Winnipeg had been caused by the taking of unpurified river water into the mains during shortages in the well-water supply. Typhoid fever death rate of Washington as compared with other southern cities and from an epidemiological standpoint may be placed in their class. For example, the death rate at Memphis, which has an exceptionally pure water supply from artesian wells, is 45.22, while Washington has a death rate of 49.30. The commission reserves its final decision on the part played by the Potomac River water in the spread of the disease, but is very emphatic in stating that the successful control of the disease lies in the destroying of the infection as it leaves the body. It also is of the opinion that the disease is prosodemic, that is, due to constant and general unhygienic conditions.

COMPARATIVE DISPOSITION OF ORGANIC MATTER BY SAND, CONTACT AND SPRINKLING FILTERS.* A general and comparative article on the operation of these

* H. W. Clark, Engineering News, 57, 607.

three types of sewage filters, accompanied by careful summaries based upon the work and present condition of sand filters that have been operated nineteen years, contact filters that have been operated six years and sprinkling filters that have been operated nearly eight years, each and all receiving Lawrence (Mass.) sewage. From 50 per cent to 75 per cent of the matter in suspension in sewage is organic, and less than 8 per cent of this is nitrogen, the rest is carbonaceous matter. The total organic matter in the sewage at Lawrence has amounted on the average to 2,800 pounds per million gallons, and the suspended matter to 2,080 pounds. The suspended matter composed of 70 per cent organic or volatile matter and 30 per cent human matter. Of the organic matter 2.6 per cent has been organic nitrogen. The remainder has been carbonaceous containing 40 per cent of carbon and 22 per cent of fatty matters. Typical results of operation are given which cannot be reproduced, but which are well worth reading. Each filter performs a different office. Each sand filter produces a practically odorless and highly nitrified effluent. The rate of filtration, however, can rarely exceed 100,000 gallons per acre when receiving strong sewage. Contact filters allow rates six to eight times as great as sand filters, but only the best give non-putrescible effluents. Trickling filters can be operated with normal sewage at rates at least three or four times as great as contact filters and twenty times as great as sand filters. They produce a highly nitrified, practically odorless and non-putrescible effluent, which, however, contains considerable suspended matter which must be removed in many cases. The organic matter which is applied to the filters with the sewage is of two kinds, stable and unstable. This matter accumulates to a greater or less degree in all filters, but most of all in the sand filter and least in the trickling filter. The accumulation in the sand filter has to be removed by scraping, while in the trickling filter it is dislodged from the filter-

ing material and passes through with the effluent in large quantities. Contact filters are very apt to accumulate organic matter, but there is some chance that part of it will be oxidized, especially that part which putrefies in the filter. The article bristles with facts and the conclusions are based upon many years' experience in each case.

WATER PURIFICATION AT ST. LOUIS.* Author gives results of operation of coagulating basins at Chain-of-Rocks, where are treated a daily average of 70,000,000 gallons of good water having a turbidity of over 1,200, a color of over 40 and an alkalinity of over 135 parts per million. Ferrous sulphate is added to the water, then milk of lime, and the water is clarified in six subsiding basins. Four new basins are being added. The amount of the constituents of the water fluctuates continually. An increase of 2,000 parts of suspended matter a million within twenty-four hours is not uncommon. The process removes about 99 per cent of bacteria and reduces the turbidity to less than ten parts per million. The process also removes about 75 per cent color, 54 per cent calcium and 57 per cent magnesium. Two and thirteen-hundredths grains of ferrous sulphate and 7.39 grains of lime per gallon are required on the average. The cost of chemicals is $3.986; of labor, $0.579; of power, $0.064; for repairs, $0.063; for improvements, $0.021: a total of $4.623 a million gallons. Two per cent of the water pumped is used in cleaning the basins. A special method of slaking lime continuously in which the water used is raised 60° or 70° F. above its initial temperature by the heat developed during the slaking process has been devised by the author. The milk of lime contains one pound of lime in from three and one-half to three and three-fourths pounds of water. The residue in the slaking tanks is less than one per cent of the lime used.

* W. F. Montfort, Engineering Record, 56, 98.

TIME OF PASSAGE OF LIQUID THROUGH PERCOLATING BEDS.* The usual method of determining this has been the noting of the time between the pouring of some colored liquid on the bed and the first appearance of color at the outlet, no account being taken of the solution or its distribution over the surface. Salt solution can take the place of color to advantage in this. The average time of passing of the whole solution through the bed at any point can be recorded.

THE INTERACTION OF DILUTE SOLUTIONS OF AMMONIUM SALTS AND VARIOUS FILTERING MEDIA.† From the treatment of different media with ammonium chloride, the following conclusions have been deduced:

A. In the majority of cases appreciable absorption did take place.

B. In almost all cases the action was completed after twenty-four hours' contact.

C. The act was confined to the liquid in intimate contact with the solid.

D. Presence of supernatant liquid tending to reduce the apparent proportion of ammonium removed from solution.

E. When absorption took place solution of certain of the constituents used as media, for example, iron, calcium, etc., was effected.

F. The acid radicle of the ammonium salts was not absorbed.

Other interesting results are noted, among them that the action is due to physical structure and chemical composition, not to a biological agent; that ammonium is not removed by volatilization or oxidation, and that temperature does not affect the action. Discussion is given to the part absorption

* William Clifford, J. Soc. Chem. Ind., 26, 13.
† G. J. Fowler and P. Gaunt, J. Soc. Chem. Ind., 26, 13.

plays in nitrification. On the whole the paper is a record of careful and thorough experiments, proving some points as well as giving good suggestions for future work.

THE RELATIVE MERITS OF CHEMICALLY TREATED, SETTLED AND SEPTIC SEWAGE IN PREPARING THE LIQUID FOR OXIDIZING BEDS.* The author has recorded his nine years' experience with the sewage of Leeds, England. "The effect of chemical precipitation, simple sedimentation and septic settlement has each been investigated, and it is now intended to describe the general nature of the sewage treated, to state the facts observed in connection with each tank process, to show the connection between the respective tank effluents and the filtrates obtained from the oxidizing beds." The sewage of Leeds is not strong, but its treatment is complicated by the presence of trade wastes. The textile trades are responsible for 13 per cent of the total flow of sewage, tanneries and breweries jointly contribute 5 per cent, oil, soap and tallow works 2 per cent, chemical works 1 per cent. The dry-weather daily flow contains 5 grains of iron per gallon. Normally the combined sewage is neutral.

Various chemical precipitants were tried and a combination of 6 to 8 grains of lime and 2 grains of sulphate of alumina per gallon proved most economical. This with a twelve-hour period of sedimentation.

A period of twelve hours' plain subsidence reduced the suspended solids to about 8 grains per gallon.

The results with septic tanks show no preference for either open or covered tanks. Various periods of storage were tried. Forty-two liters of gas were evolved from 100 gallons of sewage. At a twenty-four hours' rate of flow in a period of twelve months, about 30 per cent of the suspended solids was digested in the tanks, 31 per cent passed out of the tank

*George Adam Hart, Eng. News, 84, 36.

in the effluent, and the balance of 39 per cent remained in deposit. Comparative chemical analyses of the different effluents are given, also the effluents from oxidizing beds treated with the various tank effluents. The oxygen absorbed in the four hours at 80° F. by the various effluents was as follows: crude sewage, 8.25, precipitated sewage, 2.72, settled sewage, 3.57, septic effluent, 4.25 grains per gallon. The oxygen absorbed by the effluent from the oxidizing bed treating precipitated sewage was 0.56, treating settled sewage, 0.83, treating septic effluent, 1.12 grains per gallon. The solids in suspension were as follows: crude sewage, 51.3, precipitated sewage, 4.8, settled sewage, 9.7, septic sewage, 12.5 grains per gallon. The rates of filtration were as follows, expressed as gallons per cubic yard for twenty-four hours: treating precipitated sewage, 100 gallons, treating settled sewage, 63 gallons, treating septic sewage, 63 gallons per cubic yard. The lower the relative value of the oxygen absorbed figures, the less will be the degree of oxidation to produce a non-putrescent result. A comparison of the relative suspended solid values is very instructive. For the other results the reader is referred to the original article.

USE AND ABUSE OF SEWAGE PURIFICATION PLANTS.* The author has given a discussion of the subject from the standpoint of practical results, with these questions in mind, namely, whether rivers and bodies of water have been protected by the use of sewage disposal plants, and if not, what are the causes underlying their failure to accomplish the desired ends. He describes various types of sewage disposal plants in use, taking examples from those in use in Ohio. He discusses the efficiency of these plants in detail and emphasizes especially the necessity of careful supervision of such works in order to solve the problems of operation which are fully as serious as those of construction.

* A. Elliott Kimberley, Eng. News, 58, 235.

SULPHATE OF IRON AND CAUSTIC LIME AS COAGULANTS IN WATER PURIFICATION.† The use of sulphate of alumina as a coagulant in water purification is quite generally understood, also the use of caustic lime as a reagent for water softening. Furthermore, lime and sulphate of iron in combination have been used to precipitate sewage for many years. Of late years this combination of chemicals, used originally for sewage precipitation, has been adapted to water purification. The causes of this development have been the popular prejudice against the use of alum, the low price of sulphate of iron (a by-product of the manufacture of steel) and lime, and the softening action of the lime when added to water containing calcium and magnesium bicarbonates. The adaptation of this latter process has not been an easy task, because of certain physical and chemical difficulties. The reaction is not so speedy as that with sulphate of alumina, although when the calcium is once precipitated it acts much faster than does aluminum hydrate, which is the result of the addition of alum or sulphate of alumina to water.

To begin with, the iron hydrate, which is the active coagulating agent, is precipitated in the soluble ferrous or unoxidized form and slowly oxidized to the insoluble ferric form. The coagulant must be oxidized or it will not be removed in the purification process. The main retarding agent is carbonic acid. To remove this lime is added, in excess not only of the carbonic acid but of the calcium and magnesium bicarbonates also. This addition also softens a water and, where magnesium is present, throws down magnesium hydrate, which also acts as a coagulant.

The process is particularly adapted to turbid waters containing calcium and magnesium bicarbonates. Soft waters and those containing dissolved color have not yet

† J. W. Ells, Paper read before Central Water Works Association, 1906. Also Engineering Record, 1906, page 439.

been successfully treated by this process, probably because of lack of scientific experience rather than because the process cannot be applied. The waters of the Southern seaboard are also difficult to treat, probably because of the small amount of magnesia contained in them. Experience has shown that the precipitate of calcium carbonate formed by the addition of lime to water crystallizes and settles very slowly.

In any case the process mut be controlled by a competent chemist and ample means must be employed to effect precipitation of the carbonates, lest "after deposits" be formed in filters and distribution systems. The sedimentation of turbid waters treated by this process is very rapid, because of the relatively high specific gravity of the iron hydrate (ferric hydrate). It eliminates the necessity of preliminary sedimentation often necessary where sulphate of alumina is used. Smaller coagulating basins may be used and sudden fluctuations in turbidity may be treated successfully without excessive amounts of chemicals. Most of the work of purification is therefore done in the coagulating basin, thereby relieving the filters and increasing their net capacity, as they do not require washing so frequently.

The decreased cost of the treatment is a great advantage; especially is this true where the amounts of suspended matter are large. In some cases the cost may be only one-half of the cost of sulphate of alumina. The process is already in use in several cities (St. Louis, Mo., Ashland, Ky., and others), and is to be adopted in Columbus, O., Cincinnati, O., and New Orleans, La.

THE HEALTH OF EMPLOYEES IN THE NEW YORK SUBWAY.† An article describing the general good gaseous character of the air in the New York subway, also the iron dust prevalent and the diseases, especially dry pleurisy,

†George A. Soper, Technology Quarterly, XX, 218-245.

existing among the employees, followed by recommendations for examination of the men, for preventing dust as far as practicable from entering the air and the careful removal of the same, and especially to have strict enforcement of the law against spitting in view of the longevity of some germs in the subway atmosphere.

THE DETERMINATION OF ORGANIC NITROGEN IN SEWAGE BY THE KJELDHAL PROCESS.* In this study on the direct nesslerization of Kjeldhal digestates, no special treatment for the removal of calcium is thought necessary unless the amount exceeds fifty times the nitrogen content, because calcium is seldom the cause of turbidity. Magnesium, on the other hand, even in small amounts, does interfere with the reading, and, therefore, has to be precipitated by an excess of sodium hydrate, which at the same time removes any other deleterious constitutent if such exists. In this method, as immediate filtration takes the place of the long period of settling in the previous determinations, much time is saved, with results fully as accurate as by distillation.

EXAMINATION OF WATER PURIFICATION PLANT AT OWENSBORO, KY.† A description of the new infiltration plant consisting of the 576 lineal feet of Cook well point strainers with suitable connections laid in a sand bar opposite the pumping station. The plant furnishes about 1,500,000 gallons of clear, satisfactory water per diem at no greater expense than would be incurred by the pumping of untreated river water. At the time of the examination the supply was in every way satisfactory, although it is apparent that in the future growths of Crenothrix will cause odors and tastes and a deposition of iron in the drains. The

* Leyland Whipple, Technology Quarterly, XX, 162–169.
† Philip Burgess, Eng. Rec., 56, 340.

author found no B. coli in the effluent, while the Ohio River water is considerably polluted.

WORK AT MADELEINE SEWAGE EXPERIMENT STATION, FRANCE.* A sewage experiment station has been established near Lille under the direction of the Pasteur Institute of that place, for the purpose of indicating to the authorities and private interests most practical methods of disposing their wastes, with the hope that the gross pollution of the streams in the north of France may be diminished. The station was capable of handling 500 cubic meters in twenty-four hours. The devices experimented with were septic tanks, single and double contact filters and trickling filters. The rates of operation were rather variable, but on the average were those which have been experimented with elsewhere. Results show that the removal of the suspended matter by the tanks was exceptionally good. No appreciable advantage was found in the covered septic tank over the open one. The trickling filter gave very much better results than the contact filters. The material in the trickling filter was fine slag (the run of the crusher), and the good results may have been due to the fineness of this material. The surface had to be raked occasionally to keep it porous. It acted more as a well-drained intermittent filter operating at a rate of from 500,000 to 1,000,000 gallons per diem.

WATER PURIFICATION PLANT AT EXETER, N.H.† A description of the new water filter constructed for the supply of the town of Exeter, N.H. The water supply is from an impounded reservoir occasionally contaminated with clay and organisms. The purification plant consists of coagulating basin and two mechanical filters, all constructed of concrete, and having a capacity of one million gallons per diem.

* Earle B. Phelps, Eng. News, 58, 162.
† Robert Spurr Weston, Eng. News, 58, 136.

SEWAGE EXPERIMENTS AT MATUNGA, BOMBAY.* The author describes his visit to the sewage experiment station at the Leper Colony at Matunga, near Bombay, where for nine years valuable experiments have been carried on by Mr. C. C. James, C.E. Experiments have been made with the septic tank and various types of filters, including contact beds and trickling filters. The septic tank is much more efficient than in a cold climate, and the results are the antitheses of those obtained with the domestic sewage from the Czar's palace near St. Petersburg. At Matunga the effluent was nearly free from visible solids, and the deposit in the tank need only partially to be removed at the end of three years. The temperature of the sewage varies from 78° to 90° F. Unusual quantities of gas, estimated at from 3 to 4 cubic feet per head of pollution per day, are given off, and the tank effluent is used to irrigate crops which are grown at a net profit of 45 per cent on the investment. The tank effluents in India may be filtered at a very high rate, as much as two million gallons per day being applied to trickling filters using rotary sprinklers. The contact beds have given good results with very little sign of clogging. Very good results also have been obtained by the direct application of sewage to a Ducat filter. The gas from the septic tank is used to drive a gas engine. The conditions which govern the production of gas, the studies of its composition, and the means taken to produce a gas with a minimum of nitrogen and a maximum of combustible gas are fully discussed in the text.

MAINTENANCE OF SMALL WORKS FOR TREATING SEWAGE AND WATER.† The writer notes that small water purification and sewage disposal plants fail more

* Gilbert J. Fowler, Eng. News, 58, 146.
† Editorial, Eng. Rec., 56, 332.

often because of faults of operation than because of faults of design, as it is impossible to design small plants which are "fool proof." It behooves engineers designing these small plants to urge their clients in some cases to provide for their adequate supervision by their designer, at least during the first years of operation.

PUBLIC HEALTH LEGISLATION, NEWS AND NOTES

By F. H. SLACK, M.D.
Assistant Director Boston Board of Health Laboratory

EXCLUSION OF MILK FROM TUBERCULOUS CATTLE — MONTCLAIR, N.J. A recent copy of the Sanitary Code of the Board of Health of Montclair, N.J., is of especial interest on account of the regulations concerning milk and its production, which are worthy of being taken as a model by any community desiring a pure milk supply.

Montclair has long stood in the front rank in this regard, and the latest requirement that all cows supplying milk to the town shall be proven free from tuberculosis by the tuberculin test is in line with the progressive policy of her Board of Health.

A letter issued by the Board to the Montclair public closes with this statement:

"In conclusion perhaps we should make more clear than has yet been done the object of the tuberculin test, and of the exclusion of all tuberculous cows from herds supplying milk for Montclair. The object is to contribute to the reduction of the high mortality from tuberculosis (consumption) which prevails in Montclair as elsewhere, and which in our town caused 12.2 per cent of all deaths during 1906. This disease, it is now generally accepted, may be communicated from cows to man through the milk of tuberculous cattle."

In a study of this subject from the standpoint of the producer it is a serious question, aside from a consideration of the ethics of marketing milk from tuberculous cattle,

whether such cattle are not of themselves a direct loss, yielding less revenue than would offset the cost of their maintenance. If this is the case, as is probably true, it would pay the producer to dispose of tuberculous cattle as soon as possible.

It is well known that herds producing the public milk supply of the present day are to a serious extent infected with this disease.

It would seem, in a matter so closely involving the health of the people, legislation might be agreed upon everywhere rendering the tuberculin test obligatory, killing such cattle as react, and giving a fair recompense to the producer for his immediate pecuniary loss.

BOARD OF HEALTH OF BRAZIL.* To many Americans the words "South American Republic" and "Revolution" have become almost synonymous, and the thought is often expressed that in these countries human life is held quite cheaply. Dr. Nicholas Senn of Chicago, in an interesting article in the October 19 issue of the Journal of the American Medical Association, on the "Work of the National Board of Health of the Republic of Brazil," presents in a most interesting manner the great work which is being done for the saving of human life in that country under the leadership of Dr. Oswaldo Cruz, Director General of Public Health:

"At the head of a sanitary corps of 2,200 well-trained and well-equipped men, and with the aid of a large staff of assistants specially trained for their work, he has succeeded in ridding the Brazilian coast of yellow fever and reducing the ravages of bubonic plague to a minimum. These two diseases for years and years have decimated the population of Brazil, clogged the wheels of commerce and seriously impeded the development of her boundless resources. None

* A. M. A. Journal, Oct. 19, 1907

of the many whom the Brazilians have honored by the erection of monuments and statues has done so much for the country as Dr. Cruz. He has undertaken the difficult task of fighting yellow fever and bubonic plague fearlessly and with a firm conviction that victory would crown his well-laid plans and heroic efforts.

"Dr. Cruz is the dictator of the sanitary department of the federal government. His word is law and his requests are never pigeonholed, as is only too often the case in sanitary matters in our country, from the general government down to the administration of the smallest of villages."

The work done in the Brazilian laboratories, according to Dr. Senn's description, is up to date in every detail. "The assistants, ten in number, are all young men who are well qualified for their work and who are anxious to be a credit to their master. Each one has his special work assigned to him by the director.

" Dr. Cruz receives an annual salary of $6,000 in gold, an insignificant sum considering the value of his inestimable services.

"The first two assistants receive a salary of $300 a month and the others $250 each.

"Bacteriologic, pathologic and research work and the production of prophylactic and curative sera take up the time and attention of the chief and his assistants."

A revolution or two in some of our own states might be welcomed if as a result the public health service should be organized on so admirable and progressive a basis as is that of Brazil.

BOOK REVIEWS

Report of the Storrs Agricultural Station, 1906. "*Classification of Dairy Bacteria.*"

This contribution appears in the "Report of the Storrs (Connecticut) Agricultural Station for 1906." The work was carried out in the laboratories of Wesleyan University under H. W. Conn and W. M. Esten, and in the laboratory at Storrs under W. A. Stocking. For the writing, the arrangement of the scheme of classification, and the grouping of micro-organisms, H. W. Conn assumes responsibility.

What value attaches to a classification of this nature has been and will be repeatedly asked. Especially is this true at this stage of our bacterial growth or development, which pertains to systematic or comprehensive arrangement of micro-organisms. These questions usually come from those not familiar with this branch of science or the fundamental character of the studies. Fortunately and unfortunately bacteriological results have been measured by the "yardstick" of "practical usefulness" to the layman who may not fully appreciate that the bacteriologist also seeks investigations and studies of "practical usefulness" with which the layman may not be acquainted, and which are essential to work having immediate application to dairy practices. Such work stands to the bacteriologist as a vital part of procedure or accomplishment.

To the bacteriologist the work is pregnant with possibilities, and is so presented that its usefulness in bacteriological scientific studies, while it may be lacking in much, will be immediately apparent. No worker who has experienced the chaos in this field of investigation can fail to understand its significance, for it will not only reduce the amount of ambiguity existing, but will clear away the mist enshrouding many

descriptions, and will diminish the number of dairy micro-organisms launched as distinct species, new species, or varieties, but its greatest influence will be felt upon future work by creating an exacting spirit, when a micro-organism is to be treated as a known species or is to be presented as a *débutante*. It will call to line. It will aid materially by its uplifting tendencies.

It matters little whether in many of its details it will provoke harmony or discord; one result is assured, it will provoke a spirit which will work for good. Its importance lies in its inception and direction.

Any review of this contribution would fail or fall short without the words of the author as a preface: "The previous paper (referring to the description of dairy bacteria, by H. W. Conn in 1899) has served a purpose. It was recognized when it was published that it was only a temporary expedient, designed as a stepping stone towards something better. It is hoped that the present may serve a better purpose in the same direction and bring us nearer to a clear, satisfactory classification of dairy bacteria." This statement precludes criticism of a destructive character, but makes possible suggestion for future undertakings along these lines. Evidently the authors have in mind systematizing, grouping and identifying dairy bacteria. Does the scheme presented accomplish any one or all of these, considered in the light of available knowledge?

The method pursued in classifying is not generally accepted in various quarters, although it has been subjected to various modifications for one purpose and another in the hands of different authors. Probably no other classification would be as acceptable to the greater number of bacteriologists as Migula's. In selecting this system the authors were safe, because of some of the durable and elastic features embodied in it; and yet whether the specific micro-organisms of lactic fermentation are rods or spheres and like questions

may cause confusion with some who would seek mathematical precision in nature's biological form.

When the authors attempt to group, the difficulties multiply rapidly; for is it not true that when an effort is made to draw a sharp line between liquefaction and non-liquefaction of gelatin in some instances, the task resolves itself into a state of mind that is strongest by being silent? To circumvent this danger the authors have resorted to a double placing, therefore practically leaving the disputed question open. The same troubles are found in the consideration of "No Acidity in Dextrose," and "Acid in Dextrose." Is it not somewhat contradictory to find a subheading "No Acid in Dextrose" (page 188) under a grouping "Acid in Dextrose"? By reviewing page 115, the authors' interpretation will be readily understood. Any attempted grouping would meet with the same or similar obstacles. Other seeming incongruities in grouping may be found readily, but first, critics should make an investigation of the reasons leading to them, then devise some means by which they may be eliminated with the insufficient usable knowledge.

It will be for the work of the future to determine whether the factors employed to group will be satisfactory and stable. At the present time many notions prevail, and it is just as well that this plan of grouping be presented as any other, inasmuch as all are subject to unconquerable ignorance. The method used in this contribution is very simple and as sharply defined as any would likely be.

To identify means to permanently establish the life history of an organism, and, in a way, to standardize it. If this is successfully accomplished, the normal life of the organism should be known along with all its variations which are produced by what may be regarded as abnormal influences and conditions; in other words, no fact bearing upon the identity may be safely disregarded.

The authors have selected those morphological and cultural phases which have come to be considered as essential to the study of every bacterial form, notwithstanding the possible variations to which they are subject; and they recognize in them the crucial tests of identification. Other important phases they have eliminated as "confusing and unnecessary," and many descriptions as "verbose." This is playing a bold hand; for is it not true that each year is bringing about added crystallization of ideas from contributed facts? Are bacteriologists not gaining in their knowledge of species and variations by the accumulation of perhaps confusing data? Is it to be the policy of bacteriologists or their tendency to eliminate many phases of the life history of an organism or such physiological studies lest they may not be of use in identification? Or will it become bacteriological investigators to proceed along the line of exhaustive study in the hope that any facts will be useful in identification as well as for the solution of some special problems in mind? While many available facts may not be required to establish a certain system of classification, it would seem that any system of classification would be faulty in so far as it cannot satisfactorily utilize the known facts. When the authors say, "But the value of the descriptions in earlier literature varies with the completeness of the description, and the majority of these earlier described bacteria are so meager that they are absolutely worthless," then further say, "In our recent work we have tried to include in our technical routine of description all of the characteristics usually adopted for the general description of bacteria. We have, however, not adopted the practice of determining the formation of indol or the reduction of nitrates," is it not possible that the authors forget that their reviews and their present acts of identifying characters fall into the same category — both are very meager and unsatisfactory at best? It is an evolutionary process.

It is exceedingly difficult to define what characters are the leading, the important, the essential in identification or even grouping, as is often demonstrated when several competent bacteriologists work out the life history of the *same* micro-organism. While realizing the full value of most descriptions of bacteria appearing in print, there is a disposition on the part of bacteriological systematists to overlook the fact that identification as such is not intended, but rather a simple comparative differentiation for some definite object in which the investigator is interested. To identify satisfactorily is at present in a large degree beyond the power of the bacteriologist; to tentatively place seems his limitation. This should be deplored, yet it is required.

To illustrate how precarious is identification it is only necessary to refer to pages 99 to 101, upon which are set forth the inadequacy of our knowledge and the instability of the cultural characters employed. Again, such a factor as milk digestion was made dependent upon mere eye examination; the determination of aerobiosis and anaerobiosis was confined to the closed end of fermentation tubes and the mica plate method; the possible variations in milk are disregarded; the reaction of potatoes employed in the descriptions does not receive attention; and other inexact procedures are noticeable. These possible variations in procedure, together with the possible variations of the micro-organisms due to temperature conditions, artificial media, et cetera, render absolute identification almost impossible.

In the matter of nomenclature it is a very doubtful practice to insert "lactis" in the name, unless it can be demonstrated that the micro-organism is strictly peculiar to milk, or at least is especially favored in its development by milk as a nutrient medium. It is very uncertain whether many of the organisms described could be thus assigned.

Going back to the purpose of the authors as stated by themselves, the object in mind has been accomplished ad-

mirably. They deserve unstinted gratitude. They have provided a good working classification, they have suggested a grouping which may stand the tests of time, and they have provided an excellent foundation for identification. The work is mainly fundamental.

CHARLES E. MARSHALL.

Sanitation in Daily Life. By ELLEN H. RICHARDS, *Instructor in Sanitary Chemistry, Massachusetts Institute of Technology. Whitcomb & Barrows, 30 Huntington Avenue, Boston, Mass. Price, 60 cents.*

In this new book Mrs. Richards again emphasizes her principle of inculcating upon growing persons the necessity of forming sanitary habits and following sanitary rules. She mentions especially the specific subjects of the clean city, the clean house, habits of cleanliness and sanitary regulations with their various sub-topics, but in a very brief way. The book is merely a collection of rules, with experiments at the end of each chapter to show the importance of these. It seems to be written for teachers, and yet at times the child is directly addressed. This fact, with the frequent repetitions, makes the whole rather inconsistent and almost unsatisfactory, as it is too far advanced for the child and too simple for the instructor.

G. I. FAIRCHILD.